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Newton Green Building Policies

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Recommending Green Building Policies for the City of Newton, MA

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Abstract

We helped the Planning and Development Department of Newton, MA in identifying policy modifications that will better promote green buildings and reduce negative impacts on the environment. We investigated the best practices of green cities across the country and found that each city uses different combinations of zoning and building regulations, incentive programs, and policies for municipal structures to advance green building. We recommended that Newton modify its policy to incorporate incentives to supplement the existing green building regulations.

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Executive Summary

The City of Newton, MA intends to increase its conservation of energy and resources through development of stronger green building policies. Green buildings are structures that significantly diminish negative impacts on the environment while also ensuring the health and comfort of their inhabitants (Greenerbuilding, 2009). In 2007 the City of Newton amended a zoning article (Article 30-24(g)) to require that any project over 20,000 sq. ft. seeking a special permit must make a "significant contribution to the efficient use and conservation of natural resources and energy." Newton currently does not have any guidelines defining what might constitute a "significant contribution." In 2009 the city extended its green building practices by adopting the Stretch Code, which has more stringent requirements than the state building code for energy conservation. However, this new code does not apply to all buildings. The Newton Department of Planning and Development is interested in making the city's green building policies even stronger, in order to promote green buildings even further.

Project Goal and Objectives

The goal of this project was to recommend modifications to Newton's zoning law as well as additional policy components that would promote green buildings. In order to achieve this goal, we completed two objectives:

1. ***Investigate how other green cities similar to Newton develop and apply zoning laws to promote green building.*** We conducted interviews with representatives of five other cities recognized for green building. We sought information on the implementation, limitations, and effectiveness of policies the cities use to promote green building. We chose cities that are mostly similar to Newton and cover a broad spectrum of green building policies. The cities that we investigated are: Arlington County, VA, Boston, MA, Cambridge, MA, Santa Monica, MA, and Seattle, WA.

2. ***Consider the limitations in Newton's zoning ordinances as well as the most feasible changes that can be made.*** We conducted interviews with various officials in Newton about the feasibility and potential success of the various green building polices of the cities we investigated. We discussed the financial, social, political, and legal limitations of each policy modification as well as what could best complement the existing zoning article and Stretch Code.

Findings

Our research revealed a variety of ways that cities use zoning laws, building codes, incentive programs, and other strategies to promote green building practices.

- ***Zoning:*** We found that most cities use their zoning laws to regulate energy efficiency and environmental impact in large building projects through open-ended clauses, similar to Newton's Article 30-24(g) that allows for flexibility in addressing green building standards. We also found that some cities incentivize green buildings through their zoning laws by placing less specific requirements on certain green technologies in order to encourage their use in the design of green buildings.

- ***Green Building Evaluation Standards:*** All cities that we investigated utilize LEED standards to define green buildings. Each city uses the standards of LEED somewhat differently, spanning from the base level of certifiable to LEED Silver certified. Officials from these green cities also recognize that additional third party certifiers such as Built Green and Built It Green provide equally suitable standards for green buildings.

- ***Green Municipal Buildings:*** Most of the cities we investigated incorporate sustainable design into the construction and renovation of their municipal buildings. They apply LEED standards to their municipal buildings in order to lead by example for private contractors.

- ***Zoning Incentives:*** Most green city officials in our sample agree that zoning incentives are effective in encouraging the development of green building. Many have found that contractors will build according to a specific green standard if they are allowed to increase the Floor Area Ratio (FAR) or the height of the building.

- ***Support and Education:*** We found that community support was a major contributing factor in the successful progress towards greener buildings. All of the exemplary green cities we studied had support from their community in favor of green building. Many of these green cities also provide educational outreach materials for developers on green building practices in order to encourage greener building within their cities.

Recommendations

We used feedback from Newton officials to determine the feasibility of applying the features of the exemplary green city policies to the City of Newton. The officials helped us identify policy modifications that may effectively promote greener buildings in Newton. We recommend that Newton take the following actions to modify its zoning laws:

- ***Create multiple guidelines that define measures to meet the "significant environmental contribution" required in Article 30-24(g).*** Newton would benefit by providing developers with guidelines that identify different options for making a significant contribution. The guidelines can use the standards of LEED Silver certifiable or offer a check list that is more focused on Newton's concerns such as water efficiency and extra

insulation and solar panels In addition, we recommend that Newton provide a separate guideline for how historic building renovations should give consideration to energy efficiency while preserving aesthetic qualities.

- ***Incorporate sustainable design into new construction and major renovations of municipal buildings.*** We recommend that Newton commit to utilizing the standards of LEED Silver in all construction and major renovations of municipal buildings. We do not necessarily recommend that the city officially certify its buildings, but certification will significantly benefit Newton's reputation as a green city. By developing greener municipal buildings, Newton will lead by example and set a standard for private developers and homeowners in Newton. Also, since municipal buildings are exempt from the Stretch Code, this new policy will even further increase green building in Newton and improve its reputation as a green city..

- ***Draft a new zoning article that will encourage the use of green technology and design techniques.*** We recommend that this new article should be dedicated to green buildings and define new green building technologies and design techniques that can receive special exemptions from FAR calculations and height restrictions. This new zoning ordinance would apply to buildings of all sizes, unlike zoning article 30-24(g), which applies to only large projects. These exemptions promote greener building by removing disincentives for green design elements that may significantly increase a structure's floor area or height. Elements such as green roofs, energy efficient mechanical systems, extra thick outer insulation, and awnings would receive specific exemptions from FAR calculations. Rooftop-mounted elements such as solar panels, small wind turbines, and energy efficient ventilation systems would receive exemptions from maximum height restrictions if they meet certain specifications that protect safety and consider aesthetics.

- ***Develop zoning incentives to further promote green building.*** An incentive program for green buildings will promote sustainable design for all sizes and types of buildings, unlike the zoning law and Stretch Code, which only affect large projects. We recommend that Newton adopt an incentive program that consists of FAR bonuses for LEED certified buildings. This would consist of a specified amount of FAR bonus to be offered, on a case by case basis, for each level of LEED that the project is certified for.

- ***Provide educational material to promote green building within the city.*** We recommend that an outreach program be directed towards r developers of small-scale projects and homeowners in Newton which would provide information on the benefits of green building and how to incorporate green building practices into their design. We recommend that Newton delegate to a third party who is educated in green building to provide the educational materials.

More details on all of these recommendations are outlined in Chapter 5 of the report. While adoption of any of these recommendations will require additional discussion and refinement within the community, we hope that they serve as feasible ideas for advancing Newton's aspirations to be a leading green city in the Commonwealth and the nation as a whole.

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Glossary

Breathing Wall: Walls that are slightly porous so as to allow the diffusion of air between the interior and exterior of the building.

Brownfield: Potentially contaminated sites from previous land usage.

Building Code: Set of laws that regulates buildings in terms of safety, health and quality of life. In the United States building codes follow the standards proposed by the International Code Council and are individually set up by the states.

Gray Water: Wastewater that is already used within the facility such from showers, dishwashers, and sinks but is not too tainted, so that it is safe for other uses such as irrigation.

Guideline: informal document general concepts for additional green building policies.

Incentive Program (zoning): Program that encourages the use of certain technologies or practices.

Infiltration: A process in which "outdoor air flows into the building through openings, joints, and cracks in walls, floors, and ceilings, and around windows and doors" (US Environmental Protection Agency, 2010).

Massachusetts General Law (MGL): Set of laws regulating the state of Massachusetts. Those laws set limitations on cities' and towns' laws.

Ordinance: A law set forth by a municipality.

Passive Solar Design: The strategy that involves taking advantage of a building's natural interaction with the position of the sun (Peterson, 2007).

Policy: A sophisticated plan embracing the general goals and acceptable actions set by governing body.

Special Buildings (Stretch Code): The Stretch Code defines special buildings to include supermarkets, laboratories, and warehouses.

Special Permit (zoning): Permit defined inside the zoning ordinance that allows exceptions in the regulation imposed by the zoning ordinance.

Zoning Ordinance: Laws regulating the land use in municipalities.

1 Introduction

Traditional practices for the construction, design, and operation of buildings take a heavy toll on the environment. The amount of energy consumed by buildings is a large contributor to the depletion of non-renewable resources (USGBC: Green Building Research, 2010). The vast development of buildings in cities has led to an overall environmental decline; as pollution increases, land is taken away from wildlife, and greenhouse gases build up in the atmosphere (US Environmental Protection Agency, 2010). According to the journalist Joan Lowy, the overconsumption of natural resources and energy by buildings destroys roughly 60% of the earth's ecosystem services (Lowy, 2005). Buildings in the US account for 39% of consumed energy and 72% of electricity consumption (USGBC: Green Building Research, 2010).

Since buildings are responsible for such a large portion of energy consumption, there is an increasing emphasis on making them "green" (Beatley, 2009). Green buildings are structures that significantly diminish negative impacts on the environment while also ensuring the health and comfort of their inhabitants (Greenerbuilding, 2009). Many American cities are engaged in transforming into greener communities in an effort to help reverse environmental decline, partly through the construction of green buildings (Beatley, 2009). America boasts numerous cities recognized internationally for their emphasis on green building, such as Arlington County, Boston, Cambridge, Santa Monica, and Seattle (Smarter Cities, 2008).

Officials in the City of Newton, MA want to increase Newton's energy efficiency and reduce its environmental impact by promoting the development of green buildings. For example, the City of Newton has recently adopted the Massachusetts Stretch Code. The Stretch Code requires that all newly constructed and renovated buildings, of a certain size, perform 20% more efficiently than what the state building code requires (Summary of the Massachusetts 'Stretch' Energy Code, 2009). The government of Newton also recently amended its zoning law to include Article 30-24(g), pertaining to special permits. This section requires contractors who propose buildings over 20,000 square feet to show that the building will contribute significantly to the efficient use and conservation of natural resources and energy (Newton's Ordinance Chapter 30: Zoning, 2009).

While the adoption of the Stretch Code and Article 30-24(g) of the zoning law are significant steps for the city, more remains to be done. The Stretch Code and zoning article also only apply to certain sizes and types of buildings, so additional components to Newton's green building policy may be desirable, in order to further promote green building (Summary of the Massachusetts 'Stretch' Energy Code, 2009). There is also still no information yet on how contractors can address the requirements of the zoning article and Newton is unsure of how to evaluate the special permit applications under section 30-24(g) (Molisnky, 2010).

The goal of this project was to recommend modifications to Newton's existing zoning law as well as additional policy components that would promote greener buildings. Our team investigated the green building policies that are already successfully implemented by thriving green cities. We also explored the constraints and opportunities for the implementation of Newton's existing green zoning article as well as the possibility of zoning amendments or new articles. This allowed us to formulate recommendations that are both feasible and have potential for success. With these recommendations, the city officials should be well prepared to draft changes to their green building policy and put them into effect to further promote green buildings.

2 Background and Literature Review

In this chapter we begin by explaining in more depth what defines green cities and how they are a core solution to restoring the environmental quality of the world. Second, we describe green buildings and explain how they are necessary for the successful development of a green city, as well as give a brief summary of the green technologies and practices that are incorporated in the construction of green buildings. The third part of the background chapter clarifies the difference between zoning laws and building codes and how they are collectively incorporated in regulating construction and renovation of both general and green buildings specifically in the City of Newton.

2.1 Green Cities

A "green city" can be defined as a community that strives to preserve the world's natural resources, while maintaining a high quality of life of its residents (Kahn, 2006). The transition towards greener cities is a response to modern civilization's negative environmental impact. In order to "regreen" the planet, efforts are being made cooperatively from international to local levels. Environmental planning professor Timothy Beatley writes, "There will be no sustainable world without sustainable cities" (Beatley, 2009). Green cities are already being established around the world in order to address the problem at a local level (Beatley, 2009). We will now explain the definition of green cities and describe the various aspects that contribute them.

A city is termed "green" when it takes into consideration the overall impact on the environment, as well as the health and safety of its residents. Green cities are often used as by communities around the world as exemplars (Beatley, 2009). Another term often used synonymously with green cities is "sustainable cities".

The Natural Resources Defense Council (NRDC) published a list of criteria that is commonly used to determine whether or not a city is green, and to determine how green that city is. Examples of these criteria are given in Table 1. These criteria are commonly accepted in many cities as important factors that affect how a green city is evaluated (Smarter Cities, 2008). The list explains these important factors as well as the methods the NRDC used to measure each criterion.

The NRDC ranks all contending green cities in America in accordance with this list of green city criteria (Smarter Cities, 2008). The overall highest ranking cities such as Seattle, San Francisco, and Portland scored well in all of the criteria, but many other cities that are accepted as green, especially the smaller cities, score highly on most or some of the criteria (Smarter Cities, 2008).

Newton, which is defined by the NRDC as a small city (population between 50,000 - 99,999 residents) ranks 83rd out of 403 evaluated green cities (Smarter Cities, 2008). Newton ranks 10th under the NRDC's standards of living criterion but does not yet have a ranking for green building (Smarter Cities, 2008). Newton intends to become a more prominent green city in America partly through incorporation of green building policies.

Table 1 – Criteria for Assessment of Green Cities

Air Quality	• How much air pollution is present in the city? • Is smoking in and around the buildings restricted?
Energy Production and Conservation	• What are the top fuels for energy production? • Are energy conservation incentives offered? • Is green power offered by the utilities?
Environmental Standards and Participation	• How many city departments have environmental standards incorporated into their policies? • Is there an environmental commission on which citizens may be served?
Green Building	• How many LEED certified buildings are there and what is the level of certification? (Certified, Silver, Gold, Platinum) • How many buildings use an alternative green building certification system? (Such as Energy Star)
Green Space	• How many individual greens spaces are included in the city? (Athletic fields, city parks, community gardens, etc.) • What percentage of the city is green space?
Recycling	• How many items are included in the city's recycling program? • What is the total amount of recycled items picked up in the recycling program? • What is the percentage of waste that is diverted from landfills?
Transportation	• What is the total amount and what is the availability of green commuting options? (Bicycle paths, bus system, carpool lanes, sidewalks / trails, etc.)
Standard of Living	• What is the percentage of owner-occupied housing? • How many of families living below the poverty line? • What is the median household income?
Water Quality and Conservation	• How many health-based and reporting-based violations has the city made regarding potable water? • How many and what kind of water conservation incentives does the city provide?

*Source: (Smarter Cities, 2008)

2.2 Green Buildings

According to the United States Green Building Council (USGBC), a green building is a structure that conserves energy and water, reduces pollutant emissions, and improves indoor air quality through the use of innovative technology and practices (USGBC: Green Building Research, 2010). More city and state governments are now requiring commercial, public, and residential buildings to follow green specifications so that the buildings and eventually the cities themselves can be qualified as green entities (Winzelberg, 2007). Buildings in general consume many vital resources such as 39% of US energy usage and 72% of US electric consumption (USGBC: Green Building Research, 2010). In the remainder of this section we discuss the environmental impact of buildings in more detail, as well as technologies for green buildings.

Green buildings can use up to 70% less energy in comparison with non-green buildings (Desbois, 2003). According to the USGBC, if all buildings in the US were to become energy efficient, there would be a reduction in US energy consumption of approximately 27% (USGBC: Green Building Research, 2010). That is equal to over a trillion kilowatt hours saved every year in the US (CIA - The World Factbook, 2009). This amount would be equivalent to saving approximately $100 billion annually in US energy costs (EIA: Electric Power Monthly - Average Retail Price of Electricity, 2010).

Buildings are also a major contributor to air pollution through their emissions, utility usage and construction wastes. According to the USGBC, non-green buildings in the US contribute 38% of the total carbon dioxide output in the air (USGBC: Green Building Research, 2010). Improved building designs would reduce greenhouse emissions by approximately 33% (USGBC: Green Building Research, 2010). Utilities such as electricity, plumbing, and sewage supply 22% of nitric oxide/nitrogen dioxide emissions that contribute to smog (US Environmental Protection Agency, 2010). Smog leads to poor air quality as it causes many health issues and damages vital vegetation (US Environmental Protection Agency, 2010).

Indoor air quality has significant impact on the occupants' comfort and health, as well as employees' performance. A study by senior journalist Christopher Palmeri on green buildings found that employees use approximately 2.9 less sick days per year in green offices as compared to non-green offices (Palmeri, 2009), suggesting that employees are healthier in green buildings. The study conducted by Palmeri reveals that 55% of the offices surveyed in the study saw an increase in employee productivity (Palmeri, 2009). A similar study found an increase in employee productivity of up to 16% (Desbois, 2003). Both of these studies imply that green buildings are healthier working environments and have a direct positive impact on employees and their performance. Palmeri also stated that based on average salaries, this use of less sick days could save an employer approximately $1,200 per employee (Palmeri, 2009). In conclusion, the employer benefits by having its employees working more often and more

productively. These findings as well as the fact that people spend 90% of their time indoors (US Environmental Protection Agency, 2010) are crucial reasons for constructing green buildings.

The impacts of building just described can be lessened with the use of green technologies and practices. Some of the aspects of sustainable design in a green building are planning, selection of materials, the use of alternative energies, and the optimization of indoor and outdoor air quality. Table 2 briefly covers most of the factors that are incorporated into the design of a green building as well as examples of each factor.

2.3 The Role of City Ordinances in Promoting Green Buildings

Cities typically use either *zoning laws* or *building codes* to promote green buildings. Zoning laws and building codes differ in that zoning focuses on the land uses well as the dimensional aspects of the building, while building regulate the use of certain materials and technologies to improve energy consumption and safety in the buildings. Building codes often work together with zoning laws in promoting green buildings. This section first covers the basics of zoning laws then moves on to cover the building codes.

2.3.1 Zoning Laws

Zoning laws are set in place by local governments in order to control the use and form of land, buildings, and structures. The first zoning laws were adopted in 1916 by New York City in order to regulate the appearance of a particular building so as to minimize negative effects on the surrounding neighborhood (Molinsky, 2010). Typical zoning laws of cities and towns tend to regulate aspects of building through one of three approaches: performance zoning, form-based zoning, and incentive zoning:

- **Performance zoning** focuses on creating zoning laws that will help reduce the effects that a new structure will have on its surroundings. Forms of mitigation of the development may include building to avoid creating traffic and limiting the shape of the building to minimize the shadow of the structure (Molinsky, 2010).

- **Form-based zoning** focuses on the physical properties that the structure takes. By regulating the physical features, such as number of stories and the shape, and the construction of the structures built, the city or town is able to ensure that the structure is a safe and durable when complete (Molinsky, 2010).

- **Incentive zoning** deals with rewarding contractors for developing a structure in a manner that is desirable by the city or town. A common reward given is the ability to add floor space to the building when otherwise not allowed. This type of reward is called a Floor Area Ratio (FAR) bonus. Desirable developments may include providing public spaces, building green, or adhering to optional codes (Molinsky, 2010).

Table 2 – Outline of green building technologies and practices

Building Site Planning (LEED for New Construction & Major Renovations, 2005) Most critical step in designing a green building.	• **Building site location** Considers occupant and material transportation distance, utility availability, and Brownfield redevelopment. • **Building orientation** Applies passive solar design to minimize energy use. • **Green landscaping** Uses local landscaping materials, directs shade and rainwater flow, and requires minimal irrigation.
Building Materials and Recycling (Baker, Foss, Gillet, & Medeiros, 2003) Materials selection may be considered part of the planning step. Consideration also given to smart use of materials during entire project.	• **Production** Considers energy and resources consumed in processing and pollution produced. • **Transportation** Uses local materials. • **Recyclability/ Recycled materials** Uses materials that can be recycled or reused. Uses materials that are already recycled. • **Maintainability** Requires minimal replacement or repair. • **Health concerns** Considers harmful substances in materials.
Alternative Energy/ Energy Efficiency (Solar Energy Technologies Program: Technologies, 2008). Most common feature of green buildings (Lowy, 2005).	• **Energy saving appliances** Energy star rated • **Alternative energy** Solar Wind
Water Efficiency (LEED for New Construction & Major Renovations, 2005)	• **Using stored rainwater and gray water for irrigation** • **Installing water conserving fixtures**
Indoor Air Quality considers health and comfort of occupants	• **Minimizes pollutants in air** Infiltration and breathing walls efficiently filter pollutants (US Environmental Protection Agency, 2010) • **Regulating comfortable temperature** Geothermal heat pumps can maintain comfortable temperature while also minimizing energy consumption (Geothermal Heat Pump Heating and Cooling Systems, 2010)

Zoning laws can be made using a set up committee or through private consultants that specialize in writing zoning laws. Our sponsor, Alexandra Ananth, told us that it is likely Newton used a combination of a committee consisting of experts such as members of the Newton Planning and Development Department as well as private consultants. If the zoning laws were to ever change, the city would most likely hire private consultants, and the Board of Aldermen would have to vote on the changes made (Ananth, 2010).

Building permits are acquired through first submitting plans to submission of plans to the Inspectional Services counter in Newton City Hall. If the plan clearly follows building code and the zoning laws a permit is given. However, if the plan does not clearly follow either, it is flagged for further analysis. Special permit buildings bypass the initial analysis and are forwarded to the Zoning Code Official. After initial review, the Board of Aldermen is notified and they vote on whether the special permit is approved or denied (Ananth, 2010).

Implementing a zoning law requires ensuring that contractors and their buildings adhere to the zoning laws in place. Systematic procedures are often created in order to implement the laws in an orderly fashion. For instance, an accredited staff member is often used to review building plan submissions in order to ensure the construction follows the building code and zoning laws. Building developers often use accredited consultants to advise building projects in order to ensure that the project is following zoning law correctly (Ananth, 2010). Cities and towns often have building inspectors to look at aspects of buildings and make sure that the building is F to appropriate standards. Inspectors can periodically make sure that the use of the building continues to adhere to zoning laws and building codes. Implementation of a zoning law also requires that violations to the law be reported and handled accordingly. This means that cities and towns must monitor the buildings, and take appropriate action when a violation is in place (Molisnky, 2010)

2.3.2 Building Codes

This section focuses on the most common building energy codes as well as an extension code that the City of Newton has recently implemented. The International Energy Conservation Code (IECC), also referred to as the energy base code, is a model energy code that was established by the International Code Council (ICC, 2010). The ICC is in charge of developing building codes for commercial, residential and public buildings to ensure safety, fire protection, and energy efficiency (ICC, 2010). The IECC was established in order to promote energy efficiency in new construction and renovation projects (ICC, 2010). This policy applies to residential, public, and commercial buildings in the U.S. Also, it encourages the use of new technologies or materials, such as better insulation or alternative sources of energy.

Currently, Massachusetts is using the 2009 edition of the IECC for commercial, residential and public buildings (ICC, 2010). In comparison to the 2006 edition of the IECC, which is the most commonly used version in the United States, the 2009 IECC provides more strict regulations for buildings, which are intended to save energy consumption by 18-20%. Such energy savings are due to the technologies required in the 2009 IECC. These include, for example, improved insulation of windows, increased insulation requirements, and the use of high-efficiency lighting (ICC, 2010). The 2009 IECC provides the option to attach appendix codes on top of the base code; a clear example of this is the Stretch Code.

The Stretch Code is an appendix to the IECC 2009 released in May 2009 that requires further reductions in energy consumption, thus "stretching" the requirements of the base code (Summary of the Massachusetts 'Stretch' Energy Code, 2009). This code is an optional green building policy for cities and towns in MA (Summary of the Massachusetts 'Stretch' Energy Code, 2009). To adopt this code, a city's government needs to approve it, and it takes at least six months to one year to be mandatory. Newton voted to adopt the Stretch Code in November of 2009. It went into effect on January 1st, 2010 as an optional standard; it is not required until July 2010 (Molisnky, 2010)

The Stretch Code applies to new residential and commercial constructions and residential renovation projects. Buildings of historic importance are exempt from meeting the standards given by the Stretch Code (Q&A for MA Stretch Energy Code, 2009). In particular, the implementation of the Stretch Code requires reduction of energy consumption in new residential buildings by 20-35% on top of the base code. The Stretch Code states that commercial buildings with over 5,000 square feet of floor area and "specialty" buildings, supermarkets, laboratories, and warehouses, above 40,000 square feet in size must reduce energy consumption by 20% than what the base code requires (Stretch Energy Code, 2009). The requirement for renovations of buildings small than 2,000 sq ft is the achievement of 85 or less HERS rating. The requirement for renovations above 2,000 sq ft is the achievement of 80 or less HERS rating (Summary of the Massachusetts 'Stretch' Energy Code, 2009).

The Stretch Code also requires "real" testing to rate building energy performance. To perform such tests the Residential Energy Services Network established a standard index unit called Home Energy Rating System (HERS). The HERS index scores 100 on buildings which follow the standards of the 2006 IECC, and zero for buildings which do not consume any energy, also known as zero-net-energy buildings. The score is based on the percentage of energy savings between the new building and a building with similar dimensions that followed the 2006 IECC standards (Summary of the Massachusetts 'Stretch' Energy Code, 2009). For example, if a building is 20% more energy efficient than a building that has about the same dimensions and follows the 2006 IECC standards; the building will receive a score of 80 HERS.

Tables 3-5 present which buildings the Stretch Code covers, and what HERS index they need to attain in order to satisfy the code. Table 3 covers commercial constructions and renovations, Table 4 covers residential constructions and Table 5 covers residential renovations.

Table 3 – Application of the Stretch Code to Commercial Buildings *

	Construction	Renovation
Smaller than 5,000 sq ft	×	×
Medium sized buildings, 5,000-100,000 sq ft	×	×
Large buildings of any type over 100,000 sq ft	80 HERS or less	×
"Specialty" buildings (supermarkets, laboratories, and warehouses), below 40,000 sq ft	×	×
"Specialty" buildings over 40,000 sq ft	80 HERS or less	×
Medium sized buildings, but less than 100,000 sq ft	Optional**	×

* Sources: (Q&A for MA Stretch Energy Code, 2009); (Stretch Energy Code, 2009).

** "*First, they can use the same modeling as for buildings above 100,000 square feet, and meet the same standard of 20% below ASHRAE 90.1 2007. Alternatively, they can choose a set of "prescriptive" requirements for particular efficiency measures, based on the new base energy code for commercial buildings (International Energy Conservation Code 2009), supplemented by cost-effective energy saving enhancements taken from the Core Performance program developed by the New Buildings Institute."* (Q&A for MA Stretch Energy Code, 2009)

Table 4 – Application of the Stretch Code to New Residential Construction *

3 Stories or less	**3,000 sq ft or above**	65 HERS or less
	3,000 sq ft or less	70 HERS or less
4 Stories or more	**100,000 sq ft or less**	Follow commercial buildings standards**
	100,000 sq ft or above	

* Sources: (Q&A for MA Stretch Energy Code, 2009); (Stretch Energy Code, 2009)
** Refer to Table 3

Table 5 – Application of the Stretch Code to Residential Renovation *

3 Stories or less	**2,000 sq ft or above**	80 HERS or less
	2,000 sq ft or less	85 HERS or less
4 Stories or more	**100,000 sq ft or less**	Follow commercial buildings standards*
	100,000 sq ft or above	

* Sources: (Q&A for MA Stretch Energy Code, 2009); (Stretch Energy Code, 2009)
** Refer to Table 3

2.3.3 The Growing Use of LEED Standards.

Many cities are beginning to turn to external green building certification standards, especially LEED. Leadership in Energy and Environmental Design (LEED) is an international third-party certification that can be applied to any type of building. LEED was established by the USGBC in 1999 (LEED for New Construction & Major Renovations, 2005). LEED is used to rank and classify buildings using a scale based on one hundred points. Points are earned by meeting specific criteria that involve five main categories (100 points) and two secondary categories (10 extra points), as shown in Table 6. The certification categorizes building in four distinct levels depending on the score obtained, as shown in Table 7. In this section we focus on the third and most recent version of the LEED certification, which was released in April 2009 (USGBC: LEED, 2010)

There are numerous benefits from achieving a LEED certification. For example, obtaining certification of a sustainable project can generate some tax benefits in some cities in the United States (USGBC: LEED, 2010). However, the state of Massachusetts does not yet offer this benefit to its cities (USGBC: LEED, 2010). Also, as mentioned in Section 2.2, green construction projects can increase the productivity of employees and reduce costs to employers (Palmeri, 2009). However, the technology required for achieving a LEED certification can be relatively more expensive than the technologies used for "regular" buildings. Regardless of cost of the technology required, LEED certification can be expensive, as shown in Table 8.

Table 6 – LEED Evaluation Categories*

Category		Description	Possible Points
Main Categories	Sustainable Sites (SS)	Evaluates the selection of the site for the project, as well as the impact in the site of the construction.	26
	Water Efficiency (WE)	Evaluates the water efficiency in the construction, as well as the water pollution that causes the building in the area	10
	Energy and Atmosphere (EA)	Evaluates the energy efficiency and the atmospheric impact of the project (e.g. reductions of green house gases)	35
	Materials and Resources (MR)	Evaluates the reduction of construction waste and recycling building materials	14
	Indoor Environmental Quality (IEQ)	Evaluates the indoor air quality	15
Total			100
Secondary Categories	Innovation in Design (ID)	Evaluates the innovation in design and gives credit to any outstanding project	6
	Regional Priority (RP)	Evaluates the priority of the project in the chosen region/area	4
Total			10

* Source: (USGBC: LEED, 2010)

Table 7 – LEED Certification Grades*

Certification	Points
Certified	40–49
Silver	50–59
Gold	60–79
Platinum	80 and above

* Source: (USGBC: LEED, 2010)

Table 8 – Current Certification Fees*

	Less than 50,000 sq ft	50,000 - 500,000 sq ft	More than 500,000 sq ft
LEED version 3	Fixed Rate	Based on square footage	Fixed Rate
Design Review			
USGBC Members	$2,000	$0.04 /sq ft	$20,000
Non-Members	$2,250	$0.045 /sq ft	$22,500
Expedited Fee	$5,000 regardless of square footage		
Construction Review			
USGBC Members	$500	$0.010 / sq ft	$5,000
Non-Members	$750	$0.015 /sq ft	$7,500
Expedited Fee	$5,000 regardless of square footage		
Combined Design and Construction Review			
USGBC Members	$2,250	$0.045 / sq ft	$22,500
Non-Members	$2,750	$0.055 / sq ft	$27,500
Expedited Fee	$10,000 regardless of square footage		

*Source: (GBCI: LEED for New Construction: Certification Fees, 2010)

2.4 Zoning Laws in Newton, MA

This section covers the zoning laws existing in Newton that pertain to green building. This section will also contain excerpts from zoning chapter of the Massachusetts General Law (MGL) that are relevant to the zoning laws of local governments.

2.4.1 Zoning Regulations

In 2007 The City of Newton amended a zoning article that attempts to conserve natural resources and energy in large building projects. Chapter 30-24(g) of the Newton zoning law states that contractors applying for a special permit for projects over 20,000 square feet must give evidence to the city that the building "design, construction, or operation, makes a *significant contribution* to the efficient use of natural resources and energy" (Newton's Ordinance Chapter 30: Zoning, 2009). The significant contribution has not been defined, so there is no standard as to what the significant contribution should entail.

2.4.2 Constraints and Opportunities from Massachusetts General Law Chapter 40A.

Chapter 40A of Massachusetts General Law contains regulations on what all cities and towns of Massachusetts can or cannot do within their zoning laws. There are three sections of the MGL that particularly pertain to the limitation of zoning laws.

- **Section 3:** Section 3 states that no town or city may regulate "*Use of materials, or methods of construction of structures regulated by the state building code […]*" (MGL Chapter 40A. Zoning, 2009). The state building code contains certain parameters regarding energy efficiency and safety that each building in the state must follow, explained in Section 2.3.2, meaning that energy efficiency regulation in zoning laws has constraints.

- **Section 5:** Section 5 of Chapter 40A lists the procedure that a city or town must undergo in order to adopt or change a city zoning law. Amendment, addition, or repeal to a law is required in order for the change to be legitimate. The action must be initiated by a city council, board of selectman, board of appeals, or by voters. A city council or a committee that holds governmental power in the city must hold a public hearing in order to make the decision regarding the change, addition, or adoption of a zoning law (MGL Chapter 40A. Zoning, 2009).

- **Section 9B:** Section 9B of Chapter 40A states that ordinances and laws adopted by governments may encourage the use of solar energy systems. The ordinances and laws adopted by local governments may also constrain the height, orientation, and physical aspects of the building in order to optimize solar access (MGL Chapter 40A. Zoning, 2009).

Newton officials are interested in furthering their green building policy outside of the Stretch Code, while still adhering to the constraints of Ch. 40A. The next chapter focuses on the methodology involved with helping Newton accomplish their goal of furthering their green building policy.

3 Research Methods

The goal of this project was to recommend modifications to Newton's existing zoning law as well as additional policy components that would promote green buildings. In this chapter we describe the methods we used to address the following objectives:

1. Investigating zoning laws and additional green building policy in green cities around the US that have similar qualities to Newton.
2. Analyzing feasible policy modifications that may have potential for promoting greener building in Newton.

Two sets of research questions were developed, one set for each objective. Answering our research questions enabled us to complete our objectives and thus make appropriate recommendations for policy changes for Newton.

3.1 Objective 1: Investigating zoning laws in other green cities

Our first objective was to investigate how other green cities mostly similar to Newton develop and apply zoning laws to promote green building. We sought concrete examples of what approaches have been effective elsewhere to encourage green buildings though zoning laws and other ordinances. We prepared the following list of research questions that collectively address this objective.

1. How do these cities promote green building through zoning laws?
2. What are the standards used by other green cities to define green buildings?
3. What other measures do these cities employ to promote green building?

Answering these research questions supplied us with examples to draw upon for our recommendations to Newton. In this section we describe the methods we used to select a sample of green cities, interview relevant officials in those cities, and synthesize the results.

3.1.1 Selection of Exemplary Green Cities

In order to answer each of our research questions, we identified a list of green cities and used several criteria to select those that are mostly similar to Newton and demonstrate exemplary implementation of green building strategies:

- **National recognition for green buildings.** The NRDC compiles their lists by examining a variety of different factors including the air quality, energy production, energy conservation and green buildings, as well as other environmental factors (Smarter Cities, 2008). We used this database as our first source for identifying a lengthy list of green

cities. We were interested in selecting green cities that have a high green building rating and/or green building requirements.

- **Of interest to Newton officials.** Newton Planning Department representatives identified a list of cities that are recognized for their strong green building policies. Most of these cities are highly ranked on the NRDC database, so this list helped to narrow our selection.

- **Location.** Since we preferred to interview a portion of the representatives of these cities in person, we required several of the green cities we selected to be within a certain proximity to Newton. We preferred these nearby cities be within the state of Massachusetts so that they would have similar zoning laws to Newton, under the Massachusetts General Law.

- **Policy variation.** Since we planned on investigating a small sample of green cities, we narrowed down our final list of cities so that we could analyze the full spectrum of green building policies. We chose a balance in policies that use regulation and incentive approaches as well as policies with varying degrees of specificity. We learned about each city's policies by reviewing zoning laws and other regulations published on their websites.

- **Final List.** Our final list of green cities to include in our study consisted of: Arlington County VA, Boston MA, Cambridge MA, Santa Monica CA, and Seattle WA.

3.1.2 Interviews with Green City Officials

After indentifying the five green cities to investigate, we then identified the most relevant officials from each who are knowledgeable about zoning laws and overall green building policy. We identified interviewees by checking the city websites and contacting officials who are involved in city planning and / or environmental policies. We chose to gather information through interviews, conducted either face-to-face or by phone. Interviews were favorable because they allowed us to conduct dynamic conversations and gather more useful information. We developed a list of questions that was used as a guideline in order to ensure that we could organize all of the retrieved information for easy comparison. We also aligned our interview questions with our research questions. We altered the list of questions slightly from city to city depending on the zoning laws and other green building policy components in each city. We kept the list of questions open-ended in order to obtain more in-depth answers and ask feedback questions to clarify what the interviewee told us, which helped fill in unanticipated gaps (Knight, 2002). The interviews were conducted either via telephone or in person; dependent on the location and each interview took approximately thirty minutes to one hour. To provide further

clarification about our interviews, if needed, we followed up with the interviewee by email. A sample list of questions for green city officials is included in Appendix B.

In order to discuss topics that they would be knowledgeable in and better obtain information from each different perspective. We ran the interviews as a team, in which two students took notes and the other students were leading the interview. We chose not to tape-record the interviews since some people might feel uncomfortable with this method, which could have led to less insightful interviews. In total, we interviewed five officials in the exemplary green cities. The titles of the interviewees are listed in Table 9.

Table 9 – Interviewee Representatives

City and State	Interviewee Department
Arlington County, VA	Department of Environmental Services
Boston, MA	Environmental Department
Cambridge, MA	Community Development Department
Santa Monica, CA	Office of Sustainability and the Environment
Seattle, WA	Department of Planning and Development

3.1.3 Creation of Green City Profiles

In this section, we explain how we organized the green zoning laws, additional policy components, and implementation strategies from the cities we investigated. Our content analysis followed a general interpretive approach, in that we organized and condensed the raw text in order to uncover patterns or differences (Berg, 2007).

We organized the results of each of the cities into similarly formatted profiles, so that we could easily compare the results, especially considering the initial lack of consistency due to the use of open-ended questions. We also took the background information of each city in consideration in order to analyze each city individually. Table 10 explains the relevant background information and Table 11 explains the categories of data from interviews in green cities. The method of indexing qualitative data allowed similar and differencing themes and patterns to be grouped together for future reference (Knight, 2002).

Table 10 – Background Information Considered in Analyzing Green Policies

City population	The number of people living in the city has a strong affect on the budget supporting green building and the necessity for the city to construct new buildings.
Size of city	The size of the city affects the amount of resources and land space available for green development.
Laws that affect zoning and construction	The legal and political restrictions have a major impact on whether a specific policy can be successfully implemented in a given city.
Green city ranking	The city's current status as a green city is related to how developed or underdeveloped their green policies are.

Further comparison of the city profiles allowed us to determine the overall effectiveness of certain policies and attribute the effectiveness to certain characteristics of each city. We identified green policy components that were consistently effective in all of the unique cities. For policies that are new or not yet in full effect, we asked our interviewees their opinions on the effectiveness, as well as why and under what circumstances they were successful.

3.2 Objective 2: Identifying and analyzing possible changes to Newton's green building policies.

After synthesizing findings from our interviews with green city officials, we turned to analyzing the possible policies for Newton. In this section we outline several research questions relating to this objective. We also discuss how we addressed this objective through the interviews we conducted with Newton's officials. The following research questions guided our interviews with Newton city officials:

1. What standards should Newton use in defining how green buildings should address environmental and energy efficiency standards in accordance with Zoning Article 30-24(g)?
2. What are the views of key stakeholders on the potential effect of additional policies on promoting green buildings and how to address the limitations accompany each policy?

Table 11 – Categories of interview data

Type of policy	The policies consist of some balance between green building ordinances or incentive programs that encourage green building. The ordinance may be the zoning law, a building code, or some other type of law that will require green building.
Implementation of policy	The implementation of green policies is the actions taken by the city to ensure that buildings meet the correct green specifications. This may involve requiring submission of applications with specification checklists for given projects to a staff review board and/or employing specialty inspectors for green buildings.
Standard of evaluation	Cities may evaluate green buildings according to their own set of standards or borrow ideas from certifications such as LEED. LEED certification may even be required in some cities.
Effectiveness of policy	We will consider whether or not an implemented policy has made a significant contribution towards promoting greener buildings by speaking to green city officials.

The answers to these research questions helped us to meet our goal by identifying which ideas from each of the exemplar cities can be incorporated into Newton's green building policy. We sought to determine an effective way for Newton to define its significant environmental contribution and how they can ensure that projects meet these standards. We also sought to determine which additional policies could have the greatest impact on promoting green building in Newton by considering the gaps in the Stretch Code and the zoning law. Finally, we considered the political, financial, social, and legal restrictions on Newton's policy so that we can ensure that our recommendations are feasible.

3.2.1 Interviews with Officials in Newton

We conducted each of the interviews with officials in Newton in a similar manner to the interviews with green city officials. We interviewed a variety of officials in Newton with various perspectives on Newton's green building policy. We also made sure to consult with officials who are familiar with Newton's zoning laws. Table 12 lists each of the officials in Newton whom we interviewed, explaining their perspective and how they are relevant to zoning laws and green building policies.

We tailored all of the questions to each Newton representative that we interviewed due to their varying specializations. We have included the interview questions for each individual in Appendix C. These interview questions mostly consisted of presenting the various policies we found from other cities and discussing the feasibility of its incorporation into Newton's green building policy. We also asked questions regarding the constraints that are faced in adopting and implementing certain policies. Through the use of feedback from officials of Newton, we were better able to assess the assortment of green policies for potential success in their city. We analyzed each policy option according to perceived advantages and barriers revealed by interviewees. Then we looked for areas of agreement and disagreement among Newton city officials to identify which of the ideas might be feasible and which might not. Our methodology allowed us to gather viable research information. The research information gathered is discussed in the next chapter.

Table 12 – Newton interviewees

Inspectional Service Department	Building inspectors assess whether buildings are properly built and meet specifications such as energy efficiency. They are also involved with the historic preservation of buildings (Inspectional Services - City of Newton, MA, 2010).
Planning and Development Department – Historic Preservation	The Historic Preservation staff within the Planning and Development Department assists city with technical advice on impacts to historical buildings. They are also concerned with assisting the city with technical advice in ordinance changes, city buildings and zoning (Planning & Development - City of Newton, MA, 2010).
Representative of Public Buildings Department	This department is concerned with construction, maintenance, and repairs of Newton public buildings. The department is also concerned with renovating public buildings with designs that are energy efficient and environmentally responsible (Public Buildings Department - City of Newton, MA, 2010)
Aldermen	The Aldermen are part of Newton's government Aldermen are knowledgeable in actions that are feasible to the city and they make decisions about zoning laws for the city (Board of Aldermen - City of Newton, MA, 2010)
Building Contractor	A building contractor works for a construction management company. Building contractors are knowledgeable in green building as well as green building technologies.
Planning Consultant	A planning consultant works with the city on issues involving zoning and city planning. They are also knowledgeable in the feasibility of potential recommendations that could be made to help to Newton's green building policy.

4 Findings

We found several patterns and differences in green building policies in the cities that we investigated. This chapter begins with profiles of each of the five green cities, which reveal the wide variety of ways in which cities incorporate zoning laws, building codes, incentive programs, and other strategies into the promotion of green building practices. One of our prominent findings is that it is not typical for zoning laws and additional ordinances to regulate green building practices for smaller scale projects, so additional policies such as incentive programs are sometimes used to fully support sustainable design. We conclude this chapter by explaining which policy modifications may be feasible and most appropriate for promoting green building in the City of Newton.

4.1 Green City Profiles

In order to identify patterns in green building policies, we organized the specific green building policy components for each of the cities into profiles. Along with the background information of the cities, each profile organizes the results of our interviews into specific categories. Table 13 presents the relative statistics of each city. Then within the profiles, we explain how or whether each city incorporates green building into its zoning laws. Next, the profiles explain the standards that each city uses in defining green buildings and how the buildings should address environmental and energy efficiency concerns. The profiles conclude with explanations of additional aspects of each city's policies such as incentive programs and educational outreach.

Table 13 – Green City Statistics

City	Population*	Size**	NRDC Green City Ranking
Arlington County, VA	217,843	25.8 sq. mi.	Not Listed
Boston, MA	609,023	89.63	8th overall for large cities 9th for green buildings large cities 7th for green energy large cities 2nd for green transportation large cities
Cambridge, MA	105,596	6.26	62nd overall for medium sized cities 9th for green buildings of medium sized cities
Santa Monica, CA	87,664	15.9	106th overall for small sized cities 3rd for green buildings
Seattle, WA	598,541	142.5	1st overall green cities 1st for green buildings in the US

* (American FactFinder, 2010)

**The size (sq. mi.) was retrieved from the city government websites.

4.1.1 Arlington County, VA

Arlington County, Virginia is notable for using an incentive program as its primary means of promoting green buildings.

Zoning:

Arlington's zoning law has one article that addresses green building, article 36.H.5.a.(1), which describes that the county can grant special permits on a case by case basis for "*provisions made for open space and other environmental amenities*" (Arlington's Zoning Ordinance, 2009) The representative from Arlington whom we spoke to told us the state of Virginia is under Dillon law, which means the County needs permission from the state before they can change laws. This is the reason why Arlington cannot be more direct with their zoning regulations.

Incentive Programs:

The Green Building Bonus Density Incentive Policy has been in effect in Arlington since 1999. One half of the new county buildings and twenty-five percent of new residential buildings have gone through or are currently participating in this incentive policy. The policy gives a bonus density (Floor Area Ratio (FAR)), for each level of LEED that a building is certified for. This policy applies to "*Private developers of large office, high-rise, residential and mixed use projects*" (Arlington: Green Building Incentive Program, 2009). The added bonuses are not guaranteed, but are evaluated on a case-by-case basis. The representative we interviewed from Arlington County's Environmental Services Department stated that office buildings are generally easier to make green than residential buildings, therefore the FAR bonuses are five percent higher for residential projects than those of office projects. Since the developers in Arlington have become accustomed to constructing LEED buildings they have begun to build LEED Silver and certified on their own outside of the incentive policy. In 2009, after 10 years with this program in place, the county decreased the incentive bonuses for office buildings from 0.25 to 0.15 FAR for the LEED Silver level and from 0.15 to 0.05 FAR, for the LEED Certified level. Residential buildings also saw a similar decrease. However, the bonuses for LEED Gold and Platinum commercial buildings have stayed at the same level of 0.35 and 0.45 FAR, respectively, to entice developers to build to the next LEED level. Residential buildings saw an increase in FAR at the Gold and Platinum LEED levels in order to boost green homes.

This policy was originally introduced by a team made up of several departments of Arlington County including Environmental Services among others. The policy was put into place by the County Board. The representative from Arlington also told us that the size of the incentive bonuses was originally determined on a case-by-case basis in the beginning of the program to find the right size bonuses to give as a standard. Arlington has a 13-step program that buildings must go through for this policy, including the requirement of LEED accredited

professional to be on the project. Since this policy requires the building to be certified by LEED, Arlington can be sure that the buildings are built to code from the certification.

Green Building Standards:

Arlington County uses the LEED rating system for its green building standards. If a developer wants to construct a special permit building outside of the incentive program and not be LEED certified, the developer must go through a verification process administered by the county to ensure that the building is consistent with standards expected. This process consists of the agreement to achieve a certain number of LEED points, approval of the county board, and staff reviews with a possible site visit.

Arlington constructs all of its public and municipal buildings to be LEED Silver certified. The representative we spoke to told us that although this is not a requirement, it is an internal commitment that the city abides by and that the county has made this commitment so that they can lead by example. This sets a standard for the rest of the county by having all of the public and municipal buildings sustainable.

Green Building Education and Support:

The Green Building Bonus Density Incentive Policy includes a Green Building Fund. The Fund requires that all developers, whether they are building within the incentive policy or not, pay 4.5 cents per square foot for their building. The representative from Arlington we spoke to told us that compared to the price of the building this fee is small so the developers do not argue about paying it. If the building becomes LEED certified at any level the developer will get this money back. The rest of the money from the non-LEED certified buildings is used for educational outreach in the form of conferences, workshops and roundtables for developers to provide them with information on building green.

4.1.2 Boston, MA

The City of Boston's green building policy consists mostly of zoning regulations for large buildings. The green building zoning section requires certain buildings over 50,000 sq. ft. to be LEED certifiable. Boston also incorporates sustainable design into all of its municipal buildings in order to lead by example. Boston does not offer any financial or zoning incentives due to the high cost of grants and the high density of the city.

Zoning:

Following are pertinent sections of Boston's "Green Building" zoning article:

Section 37-1 states "*The purposes of this article are to ensure that major building projects are planned, designed, constructed, and managed to minimize adverse environmental impacts; to*

conserve natural resources; to promote sustainable development; and to enhance the quality of life in Boston" (Boston Zoning Code and Enabling Act, 2010).

Section 37-3 states, "*Any Proposed Project which is subject to or shall elect to comply with Section 80B of this Code, Large Project Review, shall be subject to the requirements of this article.*" (Boston Zoning Code and Enabling Act, 2010). Zoning section 80B defines "Large Projects" as those over 50,000 sq. ft. This section also provides a few minor examples of special case projects that are exempt from the green buildings article (Boston Zoning Code and Enabling Act, 2010).

Section 37-4 states that "*Any Proposed Project subject to the provisions of this article shall be LEED Certifiable under the most appropriate LEED building rating system. Up to four (4) of the required points may be obtained from the Boston Green Building Credits identified in Appendix A"* (Boston Zoning Code and Enabling Act, 2010). The Boston green building credits is a guideline provided by the city that addresses other green building factors not addressed by LEED. The option is given to incorporate four points from this guideline into the calculation for LEED certifiable. The four categories of the Boston Green Building Credits are:

- **Modern Grid:** Applies to projects that give consideration to minimizing the load on the power grid.
- **Historic Preservation**: Applies to green renovation of a historic building with consideration given to preserving Boston's historic aesthetics.
- **Groundwater Recharge:** Applies to projects that give consideration to capture and efficient distribution of a sufficient amount of rainwater.
- **Modern Mobility:** Applies to projects that offer amenities for energy efficient transportation.

Article 37-5 states that applicants must submit a "*completed LEED scorecard, including any Boston Green Credits that the Proposed Project will achieve. The Applicant shall demonstrate that the Proposed Project will meet the requirements of this article with appropriate supporting documentation and by certification from a LEED Accredited Professional and/or other expert recognized by the Boston Redevelopment Authority."* (Boston Zoning Code and Enabling Act, 2010).

Boston has special exemptions from section 40(a) of the Massachusetts General Law for zoning, so most of the other cities in Massachusetts may not be able to have articles with requirements as specific as Boston's in their zoning laws.

Municipal Buildings:

By executive order of the mayor, Boston requires the construction and major renovations of all of its municipal buildings to be LEED Silver certifiable in order to lead by example.

According to the Environmental Policy Analyst from the City of Boston whom we spoke to, this is part of the city's lead by example policy to encourage greener building throughout the entire city. Since Boston does not have any other regulations or incentive programs for smaller buildings, this is the only policy that Boston uses to promote greener building for projects not covered by zoning article 37.

4.1.3 Cambridge, MA

Cambridge follows a mostly regulation-based policy to promote green buildings. The city is recognized as a leader in green building by the NRDC for maintaining a task force that is addressing any impediments to green building in the city's zoning law. Cambridge also leads by example by incorporating sustainable design into its municipal buildings. Cambridge has also adopted the Massachusetts Stretch Code in 2009 for the same reasons as Newton.

Zoning:

In Cambridge's 19th zoning article, there is a section that addresses water, energy, and resource conservation for project applications for special permits.

Section 19-34(3) states "*Compliance with Leadership in Energy and Environmental Design (LEED) certification standards and other evolving environmental efficiency standards is encouraged."* (Cambridge Zoning, 2009).
This is the only zoning article directly addressing green buildings that Cambridge currently implements, but the city is considering numerous zoning modifications.

The Cambridge Green Building / Zoning Task Force analyzed the city's current zoning law in 2009 in order to identify and modify articles that inhibit or discourage the use of new green technologies or techniques. The goal of the proposed changes to Cambridge's zoning law is to "*Encourage sustainable design in construction and sustainable practices that are integrated into [their] community […]*" (Cambridge Green Building/Zoning Task Force, 2009). They found that the zoning law is currently outdated and does not recognize the existence of and unintentionally penalizes the use of new green building technologies and techniques. The Task Force recommended that the zoning law include definitions and usable GFA (Gross Floor Area) calculation exemptions for the following sustainable elements:

- Functional Green Roof Area
- Double – Skin Facades
- Additional Exterior Wall Insulation
- Pergolas
- Overhangs, Eaves and Awnings
- "Non-traditional" Mechanical Systems

The Cambridge Task Force also recommended that all future development projects "*Minimize negative shadow impacts from proposed development and tree planting on neighboring solar energy systems through good site planning and building design*" (Cambridge Green Building/Zoning Task Force, 2009). In addition, the Cambridge Task Force recommended that "*Wind turbines would be allowed throughout the city by special permit*" (Cambridge Green Building/Zoning Task Force, 2009) with special consideration given to the noise, safety, shadow, and visual impacts on the neighborhood.

In addition to eliminating zoning impediments to green technologies, the Task Force also recommended that the city adopt green building regulations in the zoning law that incorporate LEED certification standards. The Cambridge Task Force recommended the following zoning regulations:

- Projects with a GFA greater than 50,000 sq. ft. and requiring a special permit should be LEED certifiable at the Silver level.
- Projects with a GFA between 25,000 and 50,000 sq. ft. and requiring a special permit or building and site plan review should be LEED Certifiable at the base level.
- Projects with a GFA less than 25,000 sq. ft. should not have any requirement, but rather the city should provide education/ information on sustainable design.

Incentive Programs:

Cambridge does not currently have any incentive programs for green buildings. It will depend more on requiring green building for large special permit projects with their potential zoning changes and encouraging green building for all other projects. Some of the potential zoning law changes will, to an extent, incentivize greener design such as by exempting certain sustainable elements from GFA calculations.

Municipal Buildings:

A representative of the Land Use and Urban Development Department in Cambridge said that the city's internal policy requires the construction and renovations of municipal buildings to be LEED certified so that the city can lead by example.

Green Building Education and Support:

The City of Cambridge works closely with the Cambridge Energy Alliance (CEA) which is a not for profit organization that "*Provides information to homeowners, businesses and institutions across our city to achieve unprecedented levels of energy savings and to expand clean energy sources."* (Cambridge Energy Alliance, 2010). The CEA has its own professional staff and operates with other non-profit organizations.

4.1.4 Santa Monica, CA

Santa Monica uses primarily building code to accomplish its green building goals. However, the city still utilizes zoning as well as education outreach materials to ensure that buildings are kept up to green standards. Santa Monica also requires buildings to adhere to green checklists; several checklists are accepted by the city depending on what kind of building is under review.

Zoning:

Chapter 9 of Santa Monica's municipal code is the planning and zoning section. Section 9.04.06.090 states *"A neighborhood impact statement shall be prepared as part of the City's environmental review process for any project over fifteen thousand square feet […]."* (Santa Monica's Municipal Code, 2010). The neighborhood impact statement is an approximation of the impact that the building will have on its surrounding area as well as the environment. Depending on the results of the statement, Santa Monica can approve the building or have the developer mitigate the environmental impacts (City of Santa Monica 2008-2014 Housing Element, 2010).

Building Code:

Santa Monica's building code is regulated by the state in that the law cannot be *less* stringent than the code set forth by California. In fact, Santa Monica has put in place more stringent requirements than the state requires. Section 8.108 of Santa Monica's Municipal Code contains green building requirements that apply to all new construction and major renovations. This section has many specific requirements on what type of technology should be used in order to conserve energy, such as solar panels, heat traps, and pipe insulation. The building code is somewhat flexible in that there are often several options to choose from to fulfill one requirement.

For example, builders are given three options for fulfilling the Energy Code Compliance portion of the building code: 1) using a drain water heat recovery system that heats potable water by transferring the heat left over from drained water; 2) having efficient water heaters; 3) avoiding the use of mechanical air conditioning. The representative we interviewed stated that the code also gives exceptions for special cases. For instance, the code states that pools and spas must be heated using solar panels, but if the city sees that a developer's plot is shaded, this requirement will be waived.

Green Building Standards:

As one of the requirements of the building code, developers of residential buildings under four stories in height and builders of single-family houses must complete the criteria of one of three approved green checklists. The three checklist options are the LEED-Homes, Built It

Green Rated, and the Santa Monica Residential Green Building checklists. The representative we interviewed stated that the checklist made by Santa Monica is similar to the LEED checklist. Santa Monica realizes that LEED is not the only green building standard and has allowed the use of these other checklists. Buildings outside of residential parameters as well as residential buildings over four stories in height must submit a LEED checklist. LEED certification is not a requirement for any building.

Incentives:

Our Santa Monica interviewee told us about an incentive program that was recently in place that enabled Santa Monica building projects following certain green criteria to apply for grants from the city. This incentive program was called the Santa Monica Green Building Program, and it offered financial incentives for LEED certified buildings. The program was launched in April of 2004 and was in effect as of March, 2009 (USGBC: Summary of Government LEED Incentives, 2009). However, according to the official whom we contacted from Santa Monica, this program was much too costly for the city to maintain and the program was recently terminated. The official advised us that giving out grants in general proves to be too costly. Santa Monica is currently working to provide some other form of incentive for following green building criteria, but no further information is available at this time.

Green Building Education and Support:

Santa Monica provides information regarding green building on their Office of Sustainability and the Environment website. This website presents statements of the green building requirements, as well as proposed changes to the codes, and guidelines for building green homes (Santa Monica Office of Sustainability and the Environment: Green Building, 2010). Santa Monica also offers planned events to the public, such as tours of LEED platinum houses.

4.1.5 Seattle, WA

Seattle uses a combination of zoning laws, an energy code, incentive programs, internal municipal policies, and educational outreach programs to ensure that their green standard is maintained. Seattle has special considerations for green technologies in the zoning laws. Seattle also has an internal policy regarding municipal buildings and encourages particular building standards.

Zoning:

Seattle's zoning ordinance explicitly mentions green building technologies very well. Some examples of technologies that have been mentioned in the zoning laws are solar panels and green roofs. For instance, Chapter 23.44.046 states that solar panels are exempt from lot coverage calculation (City of Seattle, WA, 2010). Chapter 23.45.514 states that up to 24

additional inches can be added to structural height to accommodate a green roof covering at least 50% of the total roof area.

Seattle Energy Code (Washington State Energy Code):

The energy code in effect in Seattle is officially referred to as the Washington State Energy Code. The code provides mandatory minimal standards for new construction as well as altered buildings. The code contains separate energy codes for residential buildings and non-residential buildings (Seattle Energy Code, 2008). Design requirements for the residential portion include items such as standards for a building envelope, energy efficient cooling, and interior room conditions (Seattle Energy Code, 2008). The portion of the code for non-residential buildings also includes standards for an envelope, but also includes energy efficient standards for mechanical systems such as water heaters and humidity controls (Seattle Energy Code, 2008).

Green Task Force:

Seattle has a Green Task Force that is in charge of providing guidelines on policies to reduce energy consumption. The City of Seattle invited fifty stakeholders to sit on the Task Force, including local real-estate professionals, building developers, and experts on green buildings. The Task Force met monthly from June 2008 until January 2009 (City of Seattle, WA, 2010). The outcome of the Task Force was a policy report recommending the implementation of programs to promote green buildings, such as a loan program for residents who need money to make energy efficient upgrades. The report also recommended changes in permitting processes and changes for the Washington State Energy Code (Seattle's Green Building Capital Initiative, 2009).

Municipal Buildings:

An internal policy, known as the Sustainable Building Policy, has been in place in Seattle since 2000. This policy states that any municipal building over 5,000 sq. ft. must be LEED Silver certified. The City of Seattle has 38 city projects already finished, under construction or planned that have achieved or are targeted for LEED certification (City of Seattle, WA, 2010).

Green Building Standards:

Seattle uses two different organizations to certify its green buildings: LEED and Built Green. Used only by the state of Washington, Built Green is a third party organization that has very similar criteria to LEED. Built Green uses a star system to rate green buildings; buildings receive ratings of 1-5 stars (Built Green, 2010). Although certification by neither system is required, the government is focusing on encouraging LEED Silver or 4 Stars Built Green certification (City of Seattle, WA, 2010). The main reason for this is that Seattle has been working for over a decade to promote green building, and buildings below LEED Silver or under 4 Stars Built Green certified do not meet the expectations Seattle is encouraging. The City of

Seattle uses the encouragement of certification to address one of its main goals: to improve the energy efficiency of existing buildings by 20% (City of Seattle, WA, 2010).

Incentives:

Seattle encourages the use of green technologies by providing incentives. It has different incentive programs depending on the district. For example, the downtown districts of Seattle have an incentive program whereby every building that sets out to achieve LEED Silver or 4 Stars Green Built certified can apply for a FAR bonus. The FAR bonuses depend on the zones and normally range from 3% to 5% of the maximum FAR permitted. For instance, in the Downtown Office Core 1 Zone (DOC1), the maximum FAR is 20. However, if achieving a LEED Silver Rating, a DOC1 building can have a bonus of 1.0 FAR.

Green Building Education and Support:

The representative of Seattle we interviewed recognizes that the full support of the community has been a very important factor in the promotion of green buildings in the city. According to the representative, this support has been generated by the fact that Seattle has been leading the rankings on green buildings and green cities over the past decade. Also, Seattle has an educational outreach program directed at homeowners and developers. According to the city representative, most of the information about their incentive programs and ordinances is well organized, frequently updated on their website, and easy to access. In addition, the Seattle Department of Planning and Development supports numerous green building conferences and meetings that are open to developers and contractors.

4.2 Similarities and Differences Among Green Building Policies

In this section, we integrate and summarize the green city profiles to identify patterns and differences in green building policy approaches. Table 15 summarizes the types of policies that each of the five cities implements to promote green building. We found that each city incorporates green building into its zoning laws somewhat differently depending on the specific needs of the cities. Most cities prefer to use the standards set forth by LEED to define green buildings. We also found that there are a variety of additional policies besides zoning, such as incentive programs and municipal building policies. The following sections discuss each of these findings in more detail.

Table 14 – Summary of Green Building Policies in Five Exemplary Green Cities

	Green Building Ordinances		Incentive Programs	Green Building Standards	
	Zoning	Building Code	FAR Bonus	LEED	Other
Boston, MA	✓			✓	
Cambridge, MA	✓	✓		✓	
Arlington County, VA	✓		✓	✓	
Santa Monica, CA		✓		✓	✓
Seattle, WA	✓		✓	✓	✓

4.2.1 Each City Uniquely Incorporates Green Buildings into Zoning Laws

After comparing the various zoning laws of each of the studied green cities, we have concluded that there is no consistent approach to how cities utilize zoning laws in their green building policy. Each city incorporates zoning laws into its green building policy differently depending on the specific characteristics of the city such as how the state regulates a city's zoning. Because of this, we found that some city's zoning articles are more specific in addressing green building concerns, while others were less descriptive and more open-ended. For example, Seattle's zoning law has many specific descriptions on how certain green technologies are exempted from different regulations. Cambridge is also trying to adopt a similar approach in its zoning law. On the other end of the spectrum, we found that some cities do not have these details in their zoning law in order to allow flexibility in how to address green building concerns. The lack of specificity in zoning is also often due to state regulations. Arlington County, VA has an article in its zoning law similar to Newton's which requires "provisions made for open space and other environmental amenities" to be provided. This clause is intentionally left open to allow for different approaches to address the "environmental amenities" such as through seeking LEED certification. Other cities like Boston and Cambridge are more specific in their zoning laws by referring to LEED directly, which is still flexible since LEED certification does not require addressing all components of the checklist.

We also found a varying balance between incentivizing and regulating green building through zoning. Most cities have some type of requirement for green buildings through their zoning laws, such as through an open-ended clause or by requiring projects to adhere to LEED

standards. Santa Monica does not have green building requirements in their zoning law because the building code regulates all of its green building concerns. We found that zoning requirements in all of the cities that we investigated only apply to the larger projects that often require a special permit. Because many cities chose not to implement or cannot feasibly place green building requirements on smaller projects, some choose to try incentivizing green building though zoning laws. For example, both Seattle and Cambridge want to remove many zoning limitations on certain green technologies in order to encourage greener building overall.

4.2.2 All Cities in our Sample Utilize LEED Standards to Define Green Buildings

After comparing the green building policies of the cities, we found that the policies rely mostly on third party certification standards to define green buildings. In particular, we found that all of the cities primarily use the standards provided by LEED. Most of the officials from the cities we interviewed recognized that there are other third party organizations that are equally, if not more suitable than LEED in establishing green building standards.

All of the cities that we investigated include the standards set forth by LEED to determine how projects should address green building concerns. According to the Arlington County, VA representative, the main reason why so many cities choose LEED is that it is the biggest third party organization that certifies green buildings. LEED also has plenty of experience in green building certification since it is the first organization in this field, operating since 1998. Most of the interviewees agreed that LEED addresses most aspects referring to green buildings.

The cities we investigated disagreed on whether to require LEED certification or just require that buildings follow the LEED standards without going through the LEED certification process. According to the representatives of Boston, Cambridge and Santa Monica, the main reason for requiring buildings to be LEED certifiable is to avoid the commission, time, and cost restraints that LEED certification involves. On the other hand, the representative from Arlington County suggested that developers do not mind paying the LEED process costs, since it is an insignificant portion of the cost compared to building cost as a whole.

Aside from LEED, some cities choose to also include standards from other third party organizations to define green buildings. Most of the representatives we talked to agreed that developers like to have multiple options for meeting green building standards. The primary focus of some cities is on goals such as energy and resource conservation, so they may prefer certifiers that specialize in just specific areas as opposed to all areas like LEED. However, most of the third party organizations we looked at, such as Built Green or Built It Green, use very similar criteria to LEED.

4.2.3 Most Cities Incorporate Sustainable Design into Municipal Buildings

All of the cities that we investigated, with the exception of Santa Monica, California, incorporate sustainable design into their municipal buildings either with an internal policy or by executive order. The officials whom we interviewed from each of these cities agree that it is necessary to lead by example if they are requiring private buildings to be green. All of these cities adhere to the LEED standards for their municipal buildings. The most common pattern is for cities to require their buildings to be LEED Silver certified as we found in Seattle and Arlington County.

4.2.4 Some Cities Rely on Stringent Building Codes when Zoning is Limited

We found that some cities where the zoning laws are limited by the state still have the power to adopt stringent building codes to promote green building. Santa Monica's building code allows specific regulation of energy efficiency and technical systems used within buildings, as mentioned in the Santa Monica profile. Santa Monica is allowed to create stricter building codes than the state building code so long as there is no contradiction. Cambridge has also recently adopted the Stretch Code which contains more stringent and specific energy conservation requirements than the city's existing green building zoning article.

4.2.5 Many Cities Adopt Incentive Programs as an Alternative to Zoning Regulations

We found that in many cities where the zoning regulations do not cover all sizes and types of buildings, they incorporate incentive programs into their green building policy. Some cities like Arlington County believe that encouraging green building though incentives is more effective than by enforcing green building through strict ordinances. Three out of the five cities we studied use incentive programs, and a representative of Santa Monica stated that they would like to have some in place.

Most of these cities agree that zoning incentives are effective in encouraging the development of green building. Zoning incentives also are less costly to the city than financial incentives since they do not involve distributing funds. Most of the representatives from the cities that we researched agreed that contractors would build according to a specific green standard if they were allowed to increase the FAR or the height of the building. Even the representatives from cities that did not have incentive programs agreed that incentive programs would increase the number of green buildings. However, the Boston representative interviewed believes that zoning incentives are not necessarily good for every city. Boston is already a fairly dense city, so offering an increase in FAR is not ideal for Boston since an increase in FAR increases the size of the building in relation to the property footprint. Height bonuses may also complicate matters since tall buildings block sunlight from other buildings. However, in cities that can afford to give FAR or height bonuses without becoming too dense, offering zoning

incentives to green buildings seems to be effective in encouraging building designers to make their buildings green.

4.2.6 Most Cities Recognize Educational Outreach and Community Support as Key Factors in Progress toward Greener Buildings

Community support is a major contributing factor in green building within a city. All of the exemplary green cities we studied had support from their community in favor of green building. Through our interviews with city officials, we found that a common pattern among the cities was that both residential and commercial tenants are looking and asking for more green buildings to occupy. By living in a green building a tenants would be able to save on energy costs and work or live in a healthier environment. For example, in Cambridge and Arlington, according to the representatives we spoke to from those cities, the developers are meeting this demand by building green on their own free will because the building will be more valuable. Another pattern we found is the general acceptance of green buildings and green practices. Many of the representatives we spoke to alluded to the fact that constituents are willing to contribute to green practices in order to assist their city in becoming green.

Another common pattern we found was that officials from each of the cities recognized the importance of having some time type of green building education for private developers. Many of the exemplary green cities provide education to developers on green building benefits and best practices. By providing this education they motivate developers to construct greener buildings. An example of this is Arlington's Green Building Fund, which provides resources for the education of developers on green practices. Cambridge, as well, encourages green building by meeting with developers in the permit process in order to stress the importance of green building. These examples suggest that educational outreach is an important contributing factor to green building.

4.3 Green Building Policy Options for Newton

In this section, we analyze potential green building policy changes for Newton. We found that Newton officials prefer to offer multiple options, including standards set forth by LEED, to address the "significant contribution" clause in their zoning law. We also found that there are mixed views on the best ways for Newton to further promote greener building, but the most common view is that an incentive-based approach may be most feasible and effective. Our findings also revealed that there are likely to be barriers to changing Newton's green building policy and that carefully balanced policies are necessary for policy changes to have an overall positive effect on the city. This section discusses each of these findings in more detail.

4.3.1 LEED Standards Adequately Address Zoning Article 30-24(g)

The Newton officials we interviewed agree that the significant contribution that buildings should make to the environment as stated in zoning article 30-24(g) would be well addressed by LEED standards. One of the representatives of the Planning and Development Department believes that it will be more beneficial and feasible for Newton to require projects to be LEED certifiable compared to certified. The advantage in choosing certifiable is that the developers would not have to go through the LEED certification system, which involves extra time as well as commissioning cost. The city will also avoid the use of a third party organization in regulating the construction special permit projects. The disadvantage in requiring certifiability instead of certification is that Newton staff will need to be LEED trained in order to validate the buildings. One of the advantages to certification is that the city will not be required to have trained staff in order to verify that the standards of buildings are met which would also save the city money. Lastly, buildings that are certified will have an official accreditation that they are green, and people will be encouraged by seeing the LEED logo. One must consider, however, the time, money, and resources spent during the certification process.

Newton officials whom we interviewed also recognize that some aspects of LEED are more important than others, such as conservation of energy which is specifically stated in the zoning article. They concur that other third party certification standards such as Green Built and Built It Green are very similar to those of LEED and address energy and resource conservation in a viable manner. They suggest it would be most beneficial to provide the option of a variety of third party certification standards along with a guideline specifically designed by Newton. The City of Newton has the option of constructing a checklist that consists of specific topics in LEED that are most relevant to its concerns as a green city, such as energy and resource conservation and green transportation amenities.

A representative from the Historic Preservation branch of the Planning and Development Department advises that Newton's zoning article 30-24(g) and other green building policies should give consideration to aesthetics of historic building districts. He points out that stricter green zoning laws could have a negative effect on historic buildings. However, he believes it is still possible for most historic buildings to undergo green renovations and retrofits while still preserving their aesthetics. He suggests a couple of solutions to address the compromise between sustainable design and historic buildings, for example by requiring energy audits for historic building renovations and by providing a separate guideline for zoning article 30-24(g) that is specific to historic buildings and districts. This guideline would provide measures for increasing the energy and resource conservation of the building that do not have an effect on historic aesthetics.

4.3.2 Incentive Programs May Have a Widespread Positive Effect on Promoting Green Building in Newton

Most of the key stakeholders in the City of Newton whom we interviewed agreed that incentive programs are feasible and have potential to effectively promote green building. Due to limitations in the zoning law and building code, incentive programs can be beneficial because they can promote sustainable design of all building types and sizes. Even though a representative from the public buildings department believes that zoning laws and additional ordinances should be as strict as possible in promoting green building, there is not much that can be done to make them any more stringent than they are. In particular, our interviewees agree that financial incentives in which grants are given are too costly and not feasible for Newton. Instead, they recognize zoning incentives such as height and density bonuses as potentially having the greatest positive impact on contractors. Additionally, they identified tax cut incentives as an alternative for when height and density bonuses are not ideal in certain circumstances. A representative of the Inspectional Services Department points out that offering zoning incentives will be received more positively by contractors compared to introducing specific zoning regulations that will tell the contractors what to do. The representative explained how zoning incentives present a win–win situation for the city and contractors. Contractors will benefit from these incentives along with the bonus from energy savings, and Newton can benefit from additional taxes on larger buildings. The negative impact of large buildings will also be nullified by the fact that the building is green. The Inspectional Services representative also points out that excessive regulations can either discourage contractors from doing work in overly restrictive cities or cause contractors to find ways around the rules. A representative from a local construction management company agrees with this argument of incentives versus restrictions. The representative identifies height and density bonuses, tax cuts, and expedited permitting as equally effective incentives for contractors to build green. One of the Aldermen of Newton also recognizes the potential of height and density bonuses in Newton but believes there needs to be a balance between incentives and regulations in order to effectively promote green building.

One of the Aldermen of Newton points out those specific areas of the city would need to be identified where certain zoning incentives are most feasible. Some areas are denser than others, so depending on the site, either a height or density bonus may be more favorable. The Alderman also suggests that there could be areas where zoning incentives are not feasible at all. Officials from the Planning and Development Department also point out that height bonuses will be restricted by the community opinion that taller buildings are aesthetically undesirable.

All of the Newton officials whom we interviewed agreed that modifying all the articles in the zoning law that inhibit or discourage green building would be a feasible policy change and help to further promote green building. These potential modifications include offering FAR and dimension exemptions for certain technologies as well as protecting access of sunlight for solar panels. This type of policy could be an alternative or a supplement to a FAR bonus incentive

program. These zoning modifications would essentially offer incentive bonuses for the specific incorporation of certain green technologies as opposed to a larger bonus for projects that meet a specific green building standard. They agree that if the zoning laws support and don't penalize green design, these zoning laws may be incentive enough for contractors to build green.

There is also a general consensus that in order for Newton to have a successful incentive program, there should be an adequate educational outreach program that would be directed towards contractors of small-scale developments about sustainable design and the long-term benefits of green buildings. Many officials in Newton agree that the developers of large-scale projects are already well educated in sustainable design so that it would not be beneficial to direct and educational outreach towards them. Representatives of the Planning and Development Department agree that it would be beneficial to outsource to a third party that is more knowledgeable in sustainable design and to provide the educational outreach materials. They also suggested that this would be more beneficial due to the lack of time and resources for the City of Newton to conduct the educational outreach on its own.

4.3.3 Newton Can Feasibly Incorporate Sustainable Design into Municipal Buildings

The officials in Newton whom we interviewed agree that it would be beneficial if the city led by example in making all of its municipal buildings green so that contractors in the city would feel obligated to follow suit. By requiring its municipal buildings to be green, the Newton government will not only be leading by example, but it will also increase the overall number of green buildings in the city. They also agree that it would be feasible to adopt an internal policy which would proclaim that all municipal buildings meet a specific standard such as LEED certification / certifiability. A representative from the Planning and Development Department suggests that it would be most desirable to require municipal buildings to be LEED certifiable at the Silver level.

5 Recommendations

In this chapter, we begin with a summary of our findings followed by our recommendations of possible modifications to Newton's developing green building policy. We first recommend what standards Newton should incorporate into its existing green building zoning ordinance. Next we discuss the use of LEED standards for Newton's municipal buildings. Then we describe strategies that could be used to make zoning more friendly to green buildings in Newton. We conclude by discussing recommendations for an incentive-based policy to help promote green building.

5.1 Summary of Findings

Our research has revealed that there is a variety of approaches in which cities incorporate zoning laws, building codes, incentive programs, and other strategies into the promotion of green building practices.

- ***Zoning:*** We found that most cities use their zoning laws to regulate energy efficiency and environmental impact in large building projects through open-ended clauses, similar to Newton's Ordinance 30-24(g), that allow for flexibility in addressing green building standards. We also found that some cities incentivize green buildings through their zoning laws by placing less specific requirements on certain green technologies in order to encourage their use in the design of green buildings.

- ***Green Building Evaluation Standards:*** All cities that we investigated utilize LEED standards to define green buildings. Each city uses the standards of LEED somewhat differently, spanning from the base level of certifiable to LEED Silver certified. Officials from these green cities also recognize that additional third party certifiers such as Built Green and Built It Green provide equally suitable standards for green buildings.

- ***Green Municipal Buildings:*** Most of the cities we investigated incorporate sustainable design into the construction and renovation of their municipal buildings. They apply LEED standards to their municipal buildings in order to lead by example for private contractors.

- ***Zoning Incentives:*** Most green city officials in our sample agree that zoning incentives are effective in encouraging the development of green building. Many have found that contractors will build according to a specific green standard if they are allowed to increase the Floor Area Ratio (FAR) or the height of the building.

- ***Support and Education:*** We found that community support was a major contributing factor in the successful progress towards greener buildings. All of the exemplary green cities we studied had support from their community in favor of green building. Many of these green cities also provide educational outreach materials for developers on green building practices in order to encourage greener building within their cities.

5.2 Recommendations for Guidelines for Zoning Ordinance 30-27(g)

The purposes of these recommendations are as follows: 1) to suggest implementation guidelines for Ordinance 30-24(g) so that it reaches its full potential in promoting green building for special permit projects; and 2) to suggest additional policy components that will address buildings not covered by Ordinance 30-24g or the Stretch Code.

We recommend that Newton create guidelines that define measures to meet the "significant environmental contribution" requirement that is presented in Ordinance 30-24(g) for special permit projects. We recommend that Newton offer multiple guidelines so that developers will have several different options to choose from. Several options are listed below that could be used as guidelines for the significant contribution.

- **LEED certified/certifiable** – The Newton officials that we interviewed agree that adhering to LEED standards or equal could be considered an adequate qualification for the significant contribution requirement. Newton should utilize the standards for LEED Silver to determine if projects make the significant contribution. We recommend certifiable over certified due to the cost and timed involved with certification, but developers should not be discouraged from officially certifying their buildings.

- **LEED Checklist** - We also recommend that a significant contribution can be addressed from a selection of certain sections from the LEED 2009 Project Checklist for New Construction and Major Renovation. Building developers should focus on five out of the seven categories in which LEED points can be earned. These categories are "Sustainable Sites", "Water Efficiency", "Energy and Atmosphere", "Materials and Resources", and "Indoor Environmental Quality." These categories, as mentioned in section 2.3.3, are considered to be the main categories in LEED's evaluation, and contain the most points in the LEED system (USGBC: LEED, 2010).Newton can adopt its own scoring system for this checklist that would determine if projects adequately address the five categories.

- **Newton Checklist** – We present a checklist that focuses on energy conservation, water conservation, and indoor-air quality here. Criteria presented are per our suggestion. Newton stakeholders should also consider making a checklist of green features that reflect Newton's goals and values. No item required by the Stretch Code is included, in order to avoid redundancy. Officials from Arlington County, the Newton Public Building Department, and our representative from the Builder's Association and Housing

Committee in Newton agree that there are alternatives to LEED; therefore making a checklist is a good alternative. We recommend that Newton consider the criteria completed by a developer when deciding whether or not to give a special permit. The relevant criteria that we identified are:

- Inclusion of an insulating envelope on the exterior of the building
- Installation of solar panels
- Water efficient toilets/sinks/urinals
- Installation of an air lock for front entrance
- Drain water heat recovery system
- Building layout designed to promote indoor air quality
- Refraining from using an entire lot designated for parking space
- Dedication of land as green space for public use – to meet this criterion, developers could be asked to set aside at least 20% of the lot to be a public access area. The qualities of the area should be aesthetically pleasing, support multiple botanical species, and provide habitat for local wildlife.
- Protection of sunlight access for existing and future solar energy systems.

- **Historic Buildings Guidelines** - We also recommend that Newton present a separate guideline that will be specific to historical buildings and districts, since they are exempt from the Stretch Code. When renovations of historic buildings meet the applicability of zoning ordinance 30-24 (g), they will also be required to make the significant contribution. The historic building guidelines will describe procedures that can or cannot be done in order to increase the energy and resource conservation and not negatively impact the historic aesthetics of any historic buildings or surroundings in a historic district.

5.3 Recommendations for Municipal Buildings

We recommend that Newton lead by example by committing to incorporate sustainable design into municipal buildings. By doing this, Newton will directly increase green building in the city as well as lead by example for contractors and homeowners. This new policy will allow Newton to fill the gap in that Ordinance 30-24(g) does not apply to municipal buildings. We recommend that Newton initially focus on incorporating sustainable design into major renovations then eventually progress towards all municipal building projects. We recommend that Newton adopt LEED standards and commit its buildings to be at least LEED Silver certifiable. We suggest that Newton commit their municipal buildings be certifiable at the Silver level because more than half of the exemplary green cities, Arlington County VA, Boston MA, and Seattle WA use this level. We also feel that it is important for Newton to aspire to the Sliver level so they will lead by example in taking a large positive step for the city. The reasons why we recommend Newton to utilize the LEED standards, but not necessarily certify its municipal buildings are:

- The City of Boston does not commit its municipal buildings to be certified.
- The cost of going though official LEED certification can be avoided.
- Time can be saved by not certifying buildings.

Newton will be able to regulate its own buildings without relying on a third party organization. Although we recommend certifiable, LEED certification may be an even more beneficial standard for municipal buildings. The City of Newton will save money in a long-term period by avoiding staff training for LEED accreditation. Certification may also better encourage citizens and developers to adopt greener practices due to the added value of increasing the number of LEED certified buildings in the city.

5.4 Recommendations for Green Building Friendly Zoning

We recommend that Newton draft a new zoning ordinance that will encourage the use of green technology and design techniques. This new ordinance should define all new and emerging technologies so that they can receive special height and Floor Area Ratio (FAR) exemptions. These recommendations reflect similar changes that the City of Cambridge intends to apply to its own zoning laws. We recommend that the zoning ordinance defines the following green technologies and design techniques and exempts them from FAR calculations:

- **Green roofs:** A rooftop space that contains soil and vegetation that retains rainwater, cut down on storm water runoff, and provide natural cooling effects in the summer. Functional green roofs not intended for recreational access should be excluded from calculation of FAR**.** Green roofs that are accessible may be excluded from FAR calculation by special permit.

- **Energy efficiency mechanical systems:** Includes solar energy machinery, wind turbines, and geothermal ventilation systems and any other equipment that is related to alternative energy. All energy efficiency machinery even if not necessary for the building's operation should be excluded from calculation of FAR.

- **Extra thick outer insulation:** Adding an additional layer of insulation to the outside wall of a building can dramatically diminish energy consumption on heating and cooling. All or some portion (possibly up to six inches) should be excluded from the calculation of the FAR but setback regulations would still apply.

- **Double – skin facades:** A ventilated intermediate space between the inner and outer walls that improve insulation and reduce solar heat gain. The air space between the walls should be excluded from the FAR calculation if the space is no larger than a specified length (possibly one foot), but setback regulations would still apply.

- **Awnings:** Any overhanging elements on a building that can be incorporated in passive solar cooling of the interior and can help conserve energy. The area under any awnings or overhangs that do not exceed a specified length (possibly three feet) should be excluded from the calculation of FAR.

We also recommend that this zoning ordinance excludes rooftop mounted energy efficiency machinery from maximum height requirement for the building as long as the machinery meets certain dimension, safety, and aesthetic specifications. Some of this machinery may include:

- Solar energy systems
- Wind turbines
- Energy efficient ventilation systems

By allowing solar energy systems to be mounted higher on rooftops, their access to sunlight will be protected from future development of surrounding structures and landscaping.

In addition to the height restrictions for energy efficient machinery, we also recommend that Newton should consider promoting taller buildings though zoning in some districts that would not sacrifice community aesthetics. Taller buildings are greener in that less materials are used to construct a given usable floor area and less heat is transferred though the exterior walls from the increased volume to surface area ratio. Newton should promote taller building by extending certain height restrictions by an additional story.

5.5 Recommendations for Incentive-Based Policy

We recommend that Newton develop zoning incentives to further promote green building. This zoning incentive would involve granting FAR bonuses for LEED certified/certifiable buildings. This would consist of a certain amount of FAR bonus to be given out, on a case-by-case basis, for each level of LEED that a project is certified/certifiable for. The ability to construct larger buildings may entice contractors to use the incentive and build green. Newton will also be able to collect more revenue from property taxes due to the larger buildings. We recommend that Newton adopt an incentive program similar to Arlington's and distribute, on a case-by-case basis, to each higher level of LEED that a building achieves, incrementally higher FAR bonuses. Arlington County is more urban than Newton, so we also recommend that Newton lower these FAR bonuses to adequately fit their city. However, Newton must consider that they will have to take time and expend resources to determine the final amount of bonus FAR to distribute and to which areas this bonus FAR would be available. Also, residents might oppose the increase in density to protect the aesthetics of Newton. We recommend that Newton select either LEED certified or LEED certifiable for this policy. The same of certification versus certifiable that applied to the municipal buildings also applies to this incentive program. As a

point of reference, we show in Table 15, the FAR bonuses that Arlington County uses for their Green Building Policy.

Table 15 – FAR Bonuses in Arlington County, VA*

LEED Level	Prior to March 14, 2009	After March 14, 2009	
		Office Buildings	High-Rise Residential Complexes
Certified	0.15 FAR	0.05 FAR	0.10 FAR
Silver	0.25	0.15	0.20
Gold	0.35	0.35	0.40
Platinum	0.35	0.45	0.50

* Source: (Arlington: Green Building Incentive Program, 2009)

We recommend that Newton provide educational material to promote green building within the city. This educational outreach would be directed towards developers of small-scale projects as well as homeowners interested in renovations. We recommend that Newton provides this education in the form of a website or biannually conferences/roundtables. We also recommend that Newton delegate to a third party, such as Nexus Green Round Table, the Conservation Services Group or LEED to host such an education outreach. Most of the officials in cities that we interviewed explain that their respective cities provide some sort of educational outreach materials for developers concerning building green. More information on educational outreach programs can be found in the findings chapter in the city profiles.

More details on all of these recommendations are outlined in Chapter 5 of the report. While adoption of any of these recommendations will require additional discussion and refinement within the community, we hope that they serve as feasible ideas for advancing Newton's aspirations to be a leading green city in the Commonwealth and the nation as a whole.

Bibliography

American FactFinder. (2010). Retrieved February 23, 2010, from http://factfinder.census.gov.

Ananth, A. (2010, April 28). Senior Planner, LEED AP.

Arlington: Green Building Incentive Program. (2009, May 29). Retrieved April 29, 2010, from Official Site of Arlington County Virginia: http://www.arlingtonva.us/departments/EnvironmentalServices/epo/EnvironmentalServicesEpoIncentiveProgram.aspx.

Arlington's Zoning Ordinance. (2009, January 1). Retrieved April 27, 2010, from Official Site of Arlington County Virginia: http://www.arlingtonva.us/departments/CPHD/planning/zoning/CPHDPlanningZoningOrdinanceCode.aspx.

Baker, M., Foss, A., Gillet, A., & Medeiros, R. (2003). *IQP: Green Building Design.* Worcester, MA: Worcester Polytechnic Institute.

Beatley, T. (2009). *Sustainability 3.0. Building Tomorrow's Earth-Friendly Communities.* Retrieved February 15, 2010, from http://search.ebscohost.com/login.aspx?direct=true&db=8gh&AN=38334814&site=ehost-live.

Berg, B. L. (2007). *Qualitative Research Methods for the Social Science.* Boston, MA: Pearson.

Board of Aldermen - City of Newton, MA. (2010). Retrieved January 20, 2010, from City of Newton, MA: http://www.newtonma.gov/Aldermen/index.asp.

Boston Zoning Code and Enabling Act. (2010). Retrieved April 27, 2010, from Boston Redevelopment Authority: http://www.bostonredevelopmentauthority.org/zoning/downloadZone.asp.

Built Green. (2010). Retrieved April 27, 2010, from http://www.builtgreen.net/

Cambridge Energy Alliance. (2010). Retrieved April 27, 2010, from http://cambridgeenergyalliance.org/.

Cambridge Green Building/Zoning Task Force. (2009, November). Cambridge, MA: Obtained from City of Cambridge, Community Development Department .

Cambridge Zoning. (2009). Retrieved April 25, 2010, from City of Cambridge Home Page: http://www.cambridgema.gov/cdd/cp/zng/zord/index.html#view.

CIA - The World Factbook. (2009). Retrieved February 10, 2010, from The CIA Web Site — Central Intelligence Agency: https://www.cia.gov/library/publications/the-world-factbook/.

City of Santa Monica 2008-2014 Housing Element. (2010, July 2008). Retrieved April 27, 2010, from http://www01.smgov.net/planning/eir/Public%20Review%20Draft%20ISND.pdf.

City of Seattle, WA. (2010). Retrieved April 23, 2010, from http://www.seattle.gov/.

Desbois, M. (2003). International Conference on Indoor Air Quality/Healthy Indoor Environment. Paper presented at the Green Buildings: A Business Case., (pp. 125-149). Vancouver, BC, Canada.

EIA: Electric Power Monthly - Average Retail Price of Electricity. (2010). Retrieved February 7, 2010, from Energy Information Administration - EIA - Official Energy Statistics from the U.S. Government: http://www.eia.doe.gov/electricity/epm/table5_6_a.html.

GBCI: LEED for New Construction: Certification Fees. (2010). Retrieved April 27, 2010, from GBCI Home Page: http://www.gbci.org/main-nav/building-certification/certification-guide/leed-for-new-construction/submit-application/cert-fees.aspx.

Geothermal Heat Pump Heating and Cooling Systems. (2010). Retrieved January 25, 2010, from http://www.geoexchange.org/.

Greenerbuilding. (2009). Retrieved February 3, 2010, from http://www.greenerbuilding.org/.

ICC. (2010). Retrieved January 20, 2010, from http://www.iccsafe.org.

Inspectional Services - City of Newton, MA. (2010). Retrieved February 7, 2010, from City of Newton, MA: http://www.ci.newton.ma.us/Inspect/index.htm.

Kahn, M. E. (2006). *Green Cities: Urban Growth And the Environment.* Washington, D.C: Brookings Institution.

Knight, P. T. (2002). *Small-Scale Research.* Thousand Oaks, CA: Sage.

LEED for New Construction & Major Renovations. (2005, October). Retrieved April 4, 2010, from USGBC: U.S. Green Building Council: http://www.usgbc.org/ShowFile.aspx?DocumentID=1095.

Lowy, J. (2005, March 30). *A sobering look at global environmental decline.* Retrieved April 27, 2010, from Seattle Post-Intelligencer: http://www.seattlepi.com/national/218091_ecoreport30.html.

MGL Chapter 40A. Zoning. (2009). Retrieved April 20, 2010, from The Official Website of the Commonwealth of Massachusetts: http://www.mass.gov/legis/laws/mgl/gl-40a-toc.htm.

Molinsky, J. (2010, February 1). Introduction to the Zoning and Planning Committee. Newton, MA: Obtained from Molinsky, J.

Molisnky, J. (2010, March 15). Principal Planner/ Zoning & Planning Coordinator.

Newton's Ordinance Chapter 30: Zoning. (2009, September 29). Retrieved February 4, 2010, from City of Newton, MA: http://www.ci.newton.ma.us/legal/ordinance/Chapter-30.pdf.

Palmeri, C. (2009, December 7). *The Dividends from Green Offices.* Retrieved April 26, 2010, from BusinessWeek: http://www.businessweek.com/magazine/content/09_49/c4158btw585755.htm?chan=magazine+channel_the+business+week.

Peterson, L. (2007). *Passive Solar Design for Commercial Green Building.* Retrieved April 29, 2010, from http://www.serapdx.com/resource/publ/Green+Solar_Lisa%20P.pdf.

Planning & Development - City of Newton, MA. (2010). Retrieved March 20, 2010, from City of Newton, MA: http://www.ci.newton.ma.us/Planning/index.htm.

Public Buildings Department - City of Newton, MA. (2010). Retrieved March 22, 2010, from City of Newton, MA: http://www.ci.newton.ma.us/building/default.htm.

Q&A for MA Stretch Energy Code. (2009, Sepember 15). Retrieved February 7, 2010, from The Official Website of the Commonwealth of Massachusetts: http://www.mass.gov/Eoeea/docs/doer/gca/Stretch%20Energy%20Code%20FAQ%2010-30-09.pdf.

Santa Monica Office of Sustainability and the Environment: Green Building. (2010). Retrieved April 23, 2010, from City of Santa Monica, CA: http://www.smgov.net/departments/ose/categories/buildGreen.aspx.

Santa Monica's Municipal Code. (2010, February). Retrieved April 27, 2010, from Quality Code Publishing: http://www.qcode.us/codes/santamonica/.

Seattle Energy Code. (2008). Retrieved April 29, 2010, from The official site of the City of Seattle: http://www.seattle.gov/DPD/Codes/Energy_Code/Nonresidential/Chapter_14/default.asp.

Seattle's Green Building Capital Initiative. (2009). Retrieved April 2010, 2010, from The official site of the City of Seattle: http://www.seattle.gov/environment/documents/GBCI_2page_Summary.pdf.

Smarter Cities. (2008). Retrieved January 26, 2010, from http://smartercities.nrdc.org/.

Solar Energy Technologies Program: Technologies. (2008). Retrieved February 14, 2010, from U.S. DOE Energy Efficiency and Renewable Energy (EERE) Home Page: http://www1.eere.energy.gov/solar/technologies.html.

Stretch Energy Code. (2009). Retrieved April 20, 2010, from The Official Website of the Commonwealth of Massachusetts: http://www.mass.gov/Eeops/docs/dps/inf/appendix_120_aa_jul09_09_final.pdf.

Summary of the Massachusetts 'Stretch' Energy Code. (2009). Retrieved Juanary 26, 2010, from The Official Website of the Commonwealth of Massachusetts: http://www.mass.gov/Eeops/docs/dps/inf/stretch_code_overview_jun05_09.pdf.

US Environmental Protection Agency. (2010). Retrieved April 22, 2010, from http://www.epa.gov/.

USGBC: Green Building Research. (2010). Retrieved February 7, 2010, from USGBC: U.S. Green Building Council: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1718.

USGBC: LEED. (2010). Retrieved January 20, 2010, from USGBC: U.S. Green Building Council: http://www.usgbc.org/DisplayPage.aspx?CategoryID=19.

USGBC: Summary of Government LEED Incentives. (2009, March). Retrieved April 28, 2010, from U.S. Green Building Council: http://www.usgbc.org/ShowFile.aspx?DocumentID=2021.

Winzelberg, D. (2007, December 14). *In Suffolk, green building codes in fashion.* Retrieved April 27, 2010, from Long Island Business News: http://libn.com/blog/2007/12/14/in-suffolk-green-building-codes-in-fashion/.

Appendix A – City of Newton Planning and Development Department and Board of Aldermen

The Board of Aldermen holds many important responsibilities in the city of Newton. The Board can make, appeal, or amend any City Ordinance (Board of Aldermen - City of Newton, MA, 2010).They also hold the power to approve budgets and issue land permits (Board of Aldermen - City of Newton, MA, 2010). In all likelihood, the Board of Aldermen will be the deciding power that decides whether or not the guidelines we present are appropriate for their city

The mission of the Department of Planning and Development is "*To serve as a resource to the City's elected and appointed officials and the community at large through development review, comprehensive planning, and certain other problem-solving activities; To promote and enhance neighborhood character and quality of life; and to obtain and distribute housing and community development funds for programs, services, and neighborhood improvements that promote diversity and assist low- and moderate-income people.* " (Planning & Development - City of Newton, MA, 2010) The Planning and Development works under "the City's elected and appointed officials", which in Newton's case would be the Board of Aldermen.

Appendix B – Sample Interview Questions for Exemplary Green City Representatives

Below is the list of questions that provided the basis for the exemplar city interviews. As was stated in the Methods Chapter, the questions were altered, omitted, or added depending on green building policies and zoning laws in place, relative to each city.

1. How did the development of green building policies begin in [City]? Where did your goals come from? How has the development of green buildings affected [City] in becoming a greener city?
2. The green building policy in your city requires the [specific aspect of policy].
    a. What type of ordinance requires this? (Ex. Building code.)
    b. How did [City] decide on having these requirements? Were alternatives considered?
    c. Are you considering having these requirements for [range of building not covered]?
    d. Do you consider following requirements to be significant contributions? If not, how do you define a significant contribution?
    e. We addressed any other questions regarding the green building policies as necessary
3. [City]'s zoning law addresses green building concerns such as green space, air pollution regulations.
    a. How have these specific zoning articles contributed to the construction of greener buildings?
    b. What is the overall success rate of green zoning articles in promoting green buildings?
    c. What other zoning articles/amendments not mentioned does [City] use to support green building.
    d. [We addressed any other questions regarding zoning laws in relation to green buildings based on the zoning laws in place.]
4. How are the specific resources used in the implementation by the other cites to apply their zoning laws? (Ex. Use of inspectors and staff review)
5. Do certain codes apply to certain size buildings? If so, what are the codes that apply to each size categories?
6. What additional ordinances in addition to the zoning law embrace green building?
    a. (If MA city) What is [City]'s opinion on the Stretch Code? Does the city have any intentions on adopting this code?
7. Does [City]'s policy focus mostly on promoting green buildings through the use of incentive programs or more on implementing strict green building regulations?
8. How does [City] ensure/negotiate that green zoning amendments are passed by the Special Project Granting Authority?
    a. Are there any specific hardships that [City] overcame in enacting a new green zoning amendment? How did [City] overcome this?
9. How well does the [City] community as a whole embrace the green building policies?

Can we contact you again if we have follow up questions?

Appendix C – Interview Questions for Newton Officials

Representative from the Public Buildings Department

1. How are zoning laws different for public buildings in Newton as opposed to the private sector?
2. We understand that the Newton high school currently under construction is going to be a green building.
    a. Are there plans for the building to be LEED certified? If so, what level of certification are you looking for?
    b. What is the reasoning behind making this a green building (i.e. general promotion of green buildings, required for GCA, etc.)?
    c. Do you think this is an indication that Newton may make all of their future public buildings green?
3. Cambridge, Boston, and Arlington require that their municipal buildings be LEED certifiable or certified.
    a. Do you think that adding a zoning law that requires public or municipal buildings to be LEED certified/certifiable is feasible for Newton?
    b. How would such an implementation affect current buildings? Would requiring retrofitting be a good idea, or do you think that existing buildings would only need to go green if they require heavy renovation?
    c. Do you *feel* that a zoning law such as this would be-
        i. Supported by the community?
        ii. Supported by the Board of Aldermen, the PD department, and the Public Buildings Dep.
4. Newton's zoning law states that buildings over 20,000 ft^2 are required to make a significant contribution to the environment.
    a. What do you think defines a "significant contribution"?
5. Many of the cities that we investigated advice against offering financial incentive programs for green buildings and some suggest the use of zoning incentives.
    a. Do you think that offering zoning incentives for buildings not covered by the zoning and Stretch Code will sufficiently endorse greener building in the private sector?
    b. Do you think that a supplementary educational outreach to contractors and developers will be necessary to promote greener buildings?
6. What has Newton done so far to help its private sectors go green?
7. What impediments exist to buildings going green-
    a. In regards to public buildings?
    b. That is caused by unsupportive zoning laws?
8. Santa Monica and Seattle have stringent zoning laws that pertain to green buildings. We know that zoning laws cannot interfere with the Stretch Code's requirements or the Building Code, but can you make any recommendations to potential changes in Newton's zoning that can make buildings greener?
    a. Particularly public buildings

b. Consider subtleties such as GFA calculations for energy efficiency hardware, green roofs, and thicker outside insulation.

Representative from the Inspectional Services Department

1. Can you give us a brief description of your job and role in the Inspectional Services Department?
2. What are your thoughts on the Stretch Code?
3. Newton's green zoning law states that buildings over 20,000 ft2 are required to make a significant contribution to the environment.
    a. How is that revised by the inspectional department (paperwork? On site verification?)
    b. What do you think defines a significant contribution?
    c. Do you think that adding guidelines that define these significant contributions to the zoning law would be a good idea?
    d. Would requiring buildings to be LEED certifiable/certified effectively define a "significant contribution"
4. Cambridge, Boston, and Arlington require that their municipal buildings be LEED certifiable or certified.
    a. Do you think that adding a zoning law that requires public or municipal buildings to be LEED certified/certifiable is feasible for Newton?
5. The Cambridge Zoning Task Force recently analyzed Cambridge's zoning law and identified articles that discourage green building by not recognizing current green technologies. Examples include: GFA calculations incorporating green roofs, extra thick insulation, and area under awnings / pergolas. No height limitations on buildings surrounding structures w/ rooftop solar panels in order to limit casted shadows.
    a. Do you know of any similar articles in Newton's current zoning law that may inhibit/ discourage contractors from building green?
6. Santa Monica and Seattle have stringent zoning laws that pertain to green buildings. We know that zoning laws cannot interfere with the Stretch Code's requirements or the Building Code, but can you make any recommendations to potential changes in Newton's zoning that can make buildings greener?
    a. Particularly historic public buildings
    b. Consider subtleties such as GFA calculations for energy efficiency hardware, green roofs, and thicker outside insulation.

Representative from the Planning and Development Department (Historic Preservation)

1. Can you give us a brief description of your job and role in the Planning and Development Department?
2. We know there are differences in the laws that apply to historic buildings in comparison with laws that apply to residential and commercial buildings.
    a. Are historic buildings exempt from certain zoning laws?
3. We are assuming that historic buildings can be several hundred years old.
    a. Do these buildings usually consume more energy or less energy than modern buildings?
4. Are there any plans in Newton to make historic buildings greener?

    a. Retrofitting/renovations?
5. What are the major conflicts with renovating Historic Building to become green?
    a. Are there zoning laws that prohibit or hinder Historic buildings from becoming green?
6. Do you think that Newton is making process in becoming a greener city?
    a. Are there any specific problems you see that are hindering Newton on its path to a greener city?
7. Newton's green zoning law states that buildings over 20,000 ft^2 are required to make a significant contribution to the environment.
    a. What do you think defines a significant contribution?
    b. Do you think that adding guidelines that define these significant contributions to the zoning law would be a good idea?
    c. Would requiring buildings to be LEED certifiable/certified effectively define a "significant contribution"
8. Cambridge, Boston, and Arlington require that their municipal buildings be LEED certifiable or certified.
    a. Do you think that adding a zoning law that requires public or municipal buildings to be LEED certified/certifiable is feasible for Newton?
    b. How would such an implementation affect current buildings? Would requiring retrofitting be a good idea, or do you think that existing buildings would only need to go green if they require heavy renovation?
    c. Do you *feel* that a zoning law such as this would be-
        i. Supported by the community?
        ii. Supported by the Board of Aldermen, the PD department, and the Public Buildings Dep.?
        iii. A good idea in general?
9. Santa Monica and Seattle have stringent zoning laws that pertain to green buildings. We know that zoning laws cannot interfere with the Stretch Code's requirements or the Building Code, but can you make any recommendations to potential changes in Newton's zoning that can make buildings greener?
    a. Particularly historic public buildings?

<u>Representative form a Construction Business</u>

1. Can you give us a brief description of your job?
2. What do you consider a green building?
    a. How many LEED accredited staff are usually put on site on each of the LEED projects?
3. Why did you start to build LEED buildings?
    a. Requirement or free will?
4. What percentage of your projects are LEED buildings?
    a. Is it any more difficult to build a LEED building rather than a regular building?
    b. What is the approximate cost difference associated?
    c. Would you like to increase this number of LEED buildings you construct?- Yes
5. When you have a LEED project, is it your job to get the project LEED certified or is it the job of the building owner?

6. Have any of your projects gone through the Newton special permit process?
    a. What do these significant contributions usually entail?
    b. Would requiring buildings to be LEED certifiable/certified effectively define a "significant contribution"?
7. Cambridge is trying to make subtle green amendments to their zoning laws such as excluding thick insulated walls and green roofs from the FAR. If something of this nature was done in Newton would you be more inclined to build green buildings there?
    a. If Newton had incentive programs for developers to build green such as added height or density, would you be more inclined to build there than is they just made more strict green zoning?

<u>Representative from the Board of Aldermen</u>

1. What is your role on the Board of Aldermen (Ward, etc.)?
2. Newton's zoning law states that buildings over 20,000 ft^2 are required to make a significant contribution to the environment.
    a. What do you think defines a "significant contribution"?
3. Many of the cities that we investigated advice against offering financial incentive programs for green buildings and some suggest the use of zoning incentives.
    a. Do you think that offering zoning incentives for buildings not covered by the zoning and Stretch Code will sufficiently endorse greener building in the private sector?
    b. Do you think that a supplementary educational outreach to contractors and developers will be necessary to promote greener buildings?
4. One of Arlington County, VA's approaches to incentivizing was quite interesting. They charge a fee for all constructions (it's relatively small, 4.5¢ per square foot.) Upon LEED certification the construction would get the money from the city back. Any money the city makes off of the charges go towards green building education.
    a. How do you feel about this sort of system? Do you think a similar program can be established in Newton?
5. What has Newton done so far to help its private sectors go green?
6. What impediments exist to buildings going green that is caused by unsupportive zoning laws?
7. Santa Monica and Seattle have stringent zoning laws that pertain to green buildings. We know that zoning laws cannot interfere with the Stretch Code's requirements or the Building Code, but can you make any recommendations to potential changes in Newton's zoning that can make buildings greener?
8. We've spoken to both a representative in the Public Buildings Maintenance Department and a representative Inspectional Services. They seemed to have very different opinions about the type of zoning laws that should be in place.
    a. The representative from the Public Buildings Maintenance Department seemed to like stringency so that everyone has to build green buildings. The representative form Inspectional Services seemed to think that contractors would try to find ways to circumvent the law. This representative was a big fan of zoning incentives, because contractors would be willing to adhere the suggestions for density bonuses, etc.
    b. Where do you stand?

9. The nature of your two positions allows you to offer us a lot of insight both on the political level and the technical level of green building policies and zoning laws.

Interview with a Planning Consultant

1. What is your involvement with the City of Newton?
2. Newton's zoning law states that buildings over 20,000 ft^2 are required to make a significant contribution to the environment.
    a. What do you think defines a "significant contribution"?
    b. Do you think that adding guidelines that define these significant contributions to the zoning law would be a good idea?
    c. Would requiring buildings to be LEED certifiable/ certified effectively define a "significant contribution"?
3. Many of the cities that we investigated advice against offering financial incentive programs for green buildings and some suggest the use of zoning incentives.
    a. Do you think that offering zoning incentives for buildings not covered by the zoning and Stretch Code will sufficiently endorse greener building in the private sector?
    b. Do you think that a supplementary educational outreach to contractors and developers will be necessary to promote greener buildings?
4. One of Arlington County, VA's approaches to incentivizing was quite interesting. They charge a fee for all constructions (it's relatively small, 4.5¢ per square foot.) Upon LEED certification the construction would get the money from the city back. Any money the city makes off of the charges go towards green building education.
    a. How do you feel about this sort of system? Do you think a similar program can be established in Newton?
    b. Do you feel that contractors, etc. would be strongly opposed to such a fee, regardless of how small it is?
5. What impediments exist to buildings going green that is caused by unsupportive zoning laws?
6. Santa Monica and Seattle have stringent zoning laws that pertain to green buildings. We know that zoning laws cannot interfere with the Stretch Code's requirements or the Building Code, but can you make any recommendations to potential changes in Newton's zoning that can make buildings greener?
    a. Consider subtleties such as GFA calculations for energy efficiency hardware, green roofs, and thicker outside insulation.
7. We've spoken to both a representative in the Public Buildings Maintenance Department, a representative Inspectional Services, and an Alderman. They seemed to have very different opinions about the type of zoning laws that should be in place.
    a. The representative from the Public Buildings Maintenance Department seemed to like stringency so that everyone has to build green buildings. The representative form Inspectional Services seemed to think that contractors would try to find ways to circumvent the law. This representative was a big fan of zoning incentives, because contractors would be willing to adhere the suggestions for density bonuses, etc and the Alderman was for a combination of both incentives and regulations.
    b. Where do you stand in what you think would be best for Newton?

i. Do you believe zoning laws pertaining to green buildings should be more technical in general?
ii. We are aware that any technical aspects cannot interfere with the stretch code and building code in general.
    1. Do you have any suggestions for change that you would personally like to see that is feasible?

Appendix F – Cambridge Green Building – Zoning Recommendations

CAMBRIDGE GREEN BUILDING/ZONING

TASK FORCE

RECOMMENDATIONS

November 2009

SUBMITTED TO:

Robert W. Healy, City Manager

Richard C. Rossi, Deputy City Manager

GREEN BUILDING/ZONING TASK FORCE

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Steve Ortmann/Karen Sommerlad, Harvard University

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Timothy Rowe, Resident/Cambridge Innovation Center

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Jeff Roberts, Neighborhood Planner

Ranjit Singanayagam, Commissioner of Inspectional Services/Building Commissioner

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1. MISSION & GOALS

The Green Building/Zoning Task Force was appointed by the City Manager in April 2008 to work with City staff and analyze various approaches and to encourage energy efficient building practices. Key issues studied include adopting green building requirements such as LEED criteria for large scale developments, approach to green roofs, wind turbines, solar access, and identifying and addressing any impediments to building green in the zoning ordinance.

Task Force members represent diverse perspectives and include architects, residential owners, developers, solar installers, and representatives of advocacy groups, local universities, the Cambridge Planning Board, and City staff. The Task Force, which met monthly from April 2008 – May 2009, adopted the following mission and goals to guide their work:

"The Green Building/Zoning Task Force will develop recommendations for the City Manager on regulations and policies to encourage sustainable design in construction and sustainable practices that are integrated into our community, with the goal of reducing greenhouse gas emissions from buildings and furthering the goals established in the Cambridge Climate Action Plan. The Task Force will encourage the City to maintain its position as a leader in such practices and to serve as a model to other communities."

This mission translates into the following broad goals:

1. Propose a green building policy that significantly reduces the carbon footprint/greenhouse gas contribution from new development and significant rehab of existing buildings in Cambridge.
2. Promote development that creates healthy indoor environments and designs for energy efficiency and water efficiency as well as efficient site planning and resource efficient building materials, that result in financial benefits for owners and tenants in addition to the helping the broader environment.
3. Advance measures that improve the waste stream through reduction of construction waste and appropriate recycling of construction waste materials.
4. Create green standards that are sensitive to cost considerations and are fairly and equitably applied.
5. Identify non-regulatory tools and resources to encourage and support green design and construction in smaller projects.
6. Evaluate measures to encourage and protect solar and other renewable on-site energy systems; evaluate innovations that address the urban heat island effect such as green roofs, cool roofs, and rain gardens.
7. Formulate an education strategy to provide information about city, state, and federal programs to encourage green design and energy efficiency.
8. Investigate resources to achieve the mission described above.

This report is a compilation of the recommendations of the Green Building/Zoning Task Force addressing their principal charge. The Task Force is interested in reconvening in Winter 2009/2010 to think further about non-zoning recommendations that would support and provide incentives for sustainable building design and energy efficiency, particularly in buildings not subject to the recommended green building standards.

2. RECOMMENDATIONS

The Green Building Zoning/Task Force is forwarding the following recommendation to the City Manager to address the charge assigned to the Task Force by the City Manager and the City Council in April 2008: to propose green building requirements, such as LEED criteria for large scale developments, approach to green roofs, wind turbines, solar access, and identifying and addressing any impediments to building green in the zoning ordinance.

In instances where environmental goals have an impact on other zoning goals such as managing heights and bulk of buildings, and maintaining trees open space, the Task Force has attempted to retain a broad perspective and find the appropriate balance among competing goals. We urge consideration of the recommendations identified in the following pages to strengthen Cambridge's green building and climate protection endeavors and to affect change that is urgently needed.

I. GREEN BUILDING STANDARDS FOR LARGE DEVELOPMENT /LEED

Buildings are responsible for over 80% of the energy use and greenhouse gas emissions in Cambridge. The Task Force recommends use of LEED criteria for greening the design of large development. The topic of appropriate criteria to reference was discussed at a number of meetings. Leadership in Energy and Environmental Design (LEED) green building was selected by the majority of the Task Force members due to its wide acceptance in the marketplace and expertise in applying LEED criteria among design, engineering, and construction professionals.

RECOMMENDATION:

The proposed provision would do the following:

- Apply to new construction and rehab projects that require a special permit or development consultation.
- Require that projects meet the LEED certification criteria at the level noted. Formal certification from US Green Building Council (USGBC)/ Green Building Certification Institute (GBCI) would not be required.
- Reference the most current version of the appropriate LEED building rating system, with a twelve month phase-in period for new versions of LEED from the time of adoption by USGBC.
- Provide for review of the Ordinance after 4 years with a staff report to Planning Board every two years. Review may include a look at adopting an alternative rating system/standard in place of, or in addition to, LEED, if warranted.

Project	Requirement
GFA of 50,000 sq. ft. and greater and requiring a special permit	LEED Certifiable at the 'Silver' level
GFA of 25,000 – 50,000 sq. ft. and requiring a special permit or building and site plan review	LEED Certifiable
Less than 25,000 sq. ft.	Education/information on sustainable planning, design, and construction techniques, appropriate materials, and incentives available through state, city, utilities, and other sources

Submission Requirements:

- **At Special Permit or Development Consultation application:** A completed LEED checklist for appropriate current LEED building standard with a brief narrative on mechanisms proposed to achieve each of the credits and prerequisites. Signoff by either a LEED-AP project manager or appropriate consultants saying that to the best of their knowledge, the project has been designed to achieve the credit requirement.
- **At Building permit application:** Updated LEED checklist, narrative, and signoff. Highlight design changes, if any, and further detail where appropriate.
- **At Certificate of Occupancy application:** Final LEED checklist with updated narrative and signoff saying that to the best of their knowledge, the project has been designed and constructed to achieve the credit requirement.

NON-ZONING RECOMMENDATIONS:

In addition to the LEED requirements for large buildings, the Task Force also recommends that:

- The City provide **information on the Cambridge Energy Alliance** to all proponents along with building permit and special permit application materials.
- The City work to provide **public information on available sources of funding and technical assistance** for energy efficiency and green building.
- The City work towards **adoption of the 'Stretch' Energy Code**. The 'Stretch' Code, Appendix 120.AA of 780 CMR, was adopted by the Massachusetts Board of Building Regulations and Standards in April 2009 and provides an alternative, stronger energy code that cities may choose to adopt instead of the 'base' code.
- The City work on ways to **recognize exemplary green buildings.**

II. GREEN ROOFS

Green roofs can provide many environmental benefits, such as reducing stormwater runoff, mitigating the urban heat island effect, and reducing cooling needs. In the current zoning ordinance, roofs with access (including green roofs) are considered usable gross floor area (GFA).

RECOMMENDATION:

- **Create zoning definition for *Functional Green Roof Area***: Rooftop space that is surfaced with soil and plant materials to retain rainwater and is not usable for recreational access. **Exclude Functional Green Roof Area from the calculation of GFA** even when access to the rooftop is provided (access to a rooftop currently triggers the roof area being included in the GFA calculation above the third floor).
- Functional Green Roof Area that is designed to be usable may be exempted from the calculation of GFA by a Special Permit from the Planning Board.
- When a roof contains Functional Green Roof Area, **allow additional accessible and usable rooftop space, such as a roof deck, to be exempt from the calculation of GFA by special permit in low density residential districts** (A-1, A-2, B, C, C-1) and **as-of-right in non-residential and high-density residential districts** (C-1A, C-2, C-2A, C-2B, C-3, C-3A, C-3B).
  The exempted usable rooftop space must meet the following conditions:
  - The area of exempted usable rooftop space must be no more than 15% of the Functional Green Roof Area in size, and
  - The usable space must be set back at least 10 feet from the roof edge.

III. IMPEDIMENTS TO BUILDING GREEN IN THE ZONING ORDINANCE

The Task Force reviewed issues in the Zoning Ordinance that may inadvertently discourage incorporation of sustainable elements in building design. These are discussed below.

A. DOUBLE-SKIN FAÇADES

Double-skin façades can reduce a building's energy consumption and improve indoor environmental quality. Under the current zoning ordinance, the space between the inner and outer layers of such a façade counts as usable gross floor area (GFA).

RECOMMENDATION:

- **Create a zoning definition for *Double-Skin Façade***: A multilayer exterior wall system comprising a solid external wall, a solid internal wall, and a ventilated intermediate air space, intended to improve insulation and reduce solar heat gain.
- **Exclude the air space between solid wall segments of a Double-Skin Façade** from the calculation of GFA, provided that the space is no more than 1 foot in depth and is not intended to be accessible by building occupants except for maintenance purposes.

- In instances where a double skin façade is designed to be accessible by building occupants and the space between solid wall segments is greater than 1 foot, a special permit may be granted to permit 1 foot of the space between the wall segments to be exempt from the calculation of GFA.
- The building must still **conform to the district setback regulations.**

B. ADDITIONAL EXTERIOR WALL INSULATION

Adding insulation to the exterior of an existing building and using a greater thickness of insulation in new buildings can reduce a building's energy usage, but also adds to the calculated gross floor area (GFA) of a building without increasing the amount of usable floor space.

RECOMMENDATION:

- Refine the zoning definition of GFA to include **only the first 6 inches** of the thickness of an exterior wall (a typical thickness for an exterior wall with minimal insulation).
- Where insulation is being added to an **existing building**, the new wall **may protrude up to 4 inches into the required setback.** New buildings must conform to the district setback regulations. Fire code requirements for setback would still apply.
- Provide information to property owners of historical buildings on ways to improve energy efficiency while maintaining historical character such as siding and windows. Projects in designated Historic Districts and Neighborhood Conservation Districts would continue to require approval from the Cambridge Historical Commission or Neighborhood Conservation District Commission, as appropriate.

C. PERGOLAS

As an outdoor feature adjacent to a building or in a yard, a pergola can provide environmental benefits through shade, greenery, and improving the livability of the outdoor environment. When built over an existing paved parking area, a pergola can help reduce the heat island effect. Pergolas are not clearly defined in the zoning ordinance, and as a result the area underneath them is in some cases counted as usable gross floor area (GFA).

RECOMMENDATION:

- **Create a zoning definition for *Pergola***: A permeable outdoor structure comprising a series of unroofed beams and lattices open to the sky on which planted material may grow, which is at least 50% open across any horizontal or vertical surface. Primary parallel members of a pergola lattice must be at least 36" apart. Intervening secondary members (no larger than 1 inch x 2 inches) may be allowed.
- **Exclude** area underneath a Pergola **from the calculation of GFA**.

D. OVERHANGS, EAVES AND AWNINGS

Overhanging elements that shade the side of a building can provide passive solar cooling, reducing the demand for mechanical cooling within the building. In some cases, the space under these overhangs is counted as gross floor area (GFA).

RECOMMENDATION:

Exclude the area underneath a temporary or permanent exterior overhang or awning **from the calculation of GFA**, provided that:

- The overhang or awning must not extend more than 3 feet from the face of the exterior wall above which it is located.
- Area under the overhang or awning must be permeable, except for pathways providing access to a building entrance.

E. "NON-TRADITIONAL" MECHANICAL SYSTEMS

The Zoning Ordinance currently excludes basement, attic and rooftop mechanical spaces that are necessary for a building's operation from the definition of gross floor area (GFA). These include rooms for heating and cooling equipment, electrical and telephone facilities, and fuel storage. While most sustainable mechanical systems would also be excluded from a building's GFA, in some cases where equipment is not considered necessary for a building's operation, the zoning ordinance may not specify whether such equipment should be excluded.

RECOMMENDATION:

Clarify in the zoning ordinance that sustainable mechanical systems and related equipment and chases for systems including, but not limited to, solar energy systems, geothermal systems and heat pumps, solar hot water systems and related tubes and tanks, equipment related to radiant heating, hydronic cooling, heat recovery ventilators, energy recovery ventilators, and should be treated as mechanical systems and be excluded from the calculation of GFA. Space that continues to be usable after the inclusion of these systems will still count towards GFA.

IV. SOLAR ENERGY SYSTEMS

Protection of access to sunlight for solar energy systems is needed once they are installed.

RECOMMENDATION:

FOR ALL DEVELOPMENT PROJECTS

As-of-right Projects

Projects are encouraged to minimize negative shadow impacts from proposed development and tree planting on neighboring solar energy systems through good site planning and building design.

Special Permits and Variances

Special permit and variance considerations would include consideration of a project's impacts on neighboring solar energy systems that are:

- located 5 feet below the district height limit or higher ; and
- are on a list of solar energy systems (to be created at the Inspectional Services Department) as having received a building permit for solar energy system a year or more prior to the time of application

Projects would be asked to refer to the City's list of renewable energy systems and describe new shadow impacts, if any, that would be created as a result of the proposed development (both building and landscaping). Shadow impacts would be evaluated for December 21 during the hours of 10:00 am – 2:00 pm.

FOR PROJECTS PROPOSING SOLAR ENERGY SYSTEMS

- Building mounted solar energy systems would be included as mechanical equipment in the zoning ordinance and would not be subject to FAR and height restrictions. This includes solar photovoltaics, solar thermal systems, and solar hot water systems.
- Installation of all solar systems would require a building permit and information of address and date of permit will be noted on a list of solar energy system permits.
- Solar systems should be located and designed keeping in mind existing and potential future as-of-right development on adjacent parcels.

V. WIND TURBINES (Adopted by City Council, September 2009)

Currently, wind turbines are not explicitly allowed in the ordinance, so any wind turbine installation requires a zoning variance.

PROPOSAL:

In crafting this recommendation the Task Force has attempted to balance allowing wind turbines in the city, for their potential energy and environmental benefits, with potential impacts such as noise, shadow, and visual impacts in the neighborhood.

A two pronged approach is proposed:

1) **Wind turbines, both building mounted and free standing, would be allowed throughout the city by special permit.** A special permit approach, with case by case review by the Planning Board, is recommended, as opposed to an as-of-right approach, since the viability and impacts of small wind turbines in urban contexts have not been studied in much detail and urban wind technology is evolving at a quick pace. The special permit criteria would require proponents to describe shadow, noise, vibration, visual impacts to ensure there are not undue consequences for the neighborhood.

2) **Small building-mounted wind turbines would be allowed as of right in limited circumstances, when utilized for educational and research purposes and when located well removed from residential abutters.** It is expected that this provision would allow local institutions (such as Harvard, MIT, Museum of Science) to study the efficacy and impacts of wind turbines and advance the technology, particularly to cater to urban settings.

SPECIAL PERMIT

Applicability	• Building-mounted and free-standing wind turbines • Citywide
Special Permit Criteria	• Visual impacts on neighboring properties should be considered in wind turbine siting and selection. Turbines should not detract from neighborhood character. *Considerations*: Size, scale, and bulk of turbines in relation to the scale of the neighborhood; impact on significant viewsheds; adjacent land use; sensitivity and character of abutting buildings, particularly historical structures. • Turbines should be sited to minimize constant and intermittent shadow impacts on neighboring uses. *Considerations*: extent of shadow; frequency and duration of intermittent shadow. • Proposals in Open Space districts should receive special attention to minimize detrimental impact on the natural environment and recreational use. • Equipment should be selected, sited, and mounted to minimize noise and vibration impacts on neighboring uses. • The Planning Board may establish time limits on special permits.
Application Materials	• Plans and elevations; number, type, and size of wind turbines. • Images to demonstrate how the proposed turbines would fit in the surrounding context. • Narrative and visuals to describe equipment selection; noise rating; measures to minimize impacts on adjacent properties, if any. • Description of how laydown for maintenance is accommodated within the site and demonstration of how the wind turbine is secured if a parapet mounted turbine overhangs the public way. • Planning Board may request a shadow study and/or flicker (intermittent shadow) study.
Requirements	• Equipment shall comply with building setbacks on the parcel unless waived by the Planning Board. In districts with formula setbacks, the height of a building-mounted turbine shall not be considered when computing the setback. Height of a ground-mounted turbine shall be used to compute the setback for the turbine in these districts. • Only instrumentation related to the turbine, energy generation, and wind energy monitoring are permitted. Wind turbines may not be used to mount cellular/mobile phone equipment. • Wind turbines may not be used for signage or for display of advertising except for standard, unobtrusive identification of the manufacturer. • Wind turbines may be lighted only if required for safety by local, state, or federal regulation. Any lighting shall be shielded from abutting residential properties.

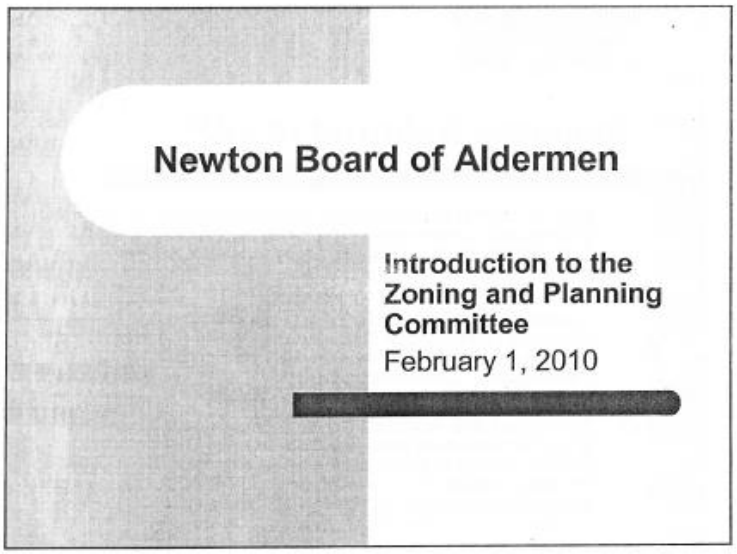
	• Brightly colored turbines are generally not encouraged unless permitted by the Planning Board or required by Federal Aviation Administration or safety considerations. • Installations on a site must be rated to meet the requirements of the Cambridge Noise Ordinance, cumulatively, for all turbines and mechanical equipment on the site. • Turbines must be sited so that laydown for maintenance occurs within the property, not on adjacent lots or on the public way.
Power capacity	• Commercial power generation facilities will not be permitted in residential districts. Turbines in residential districts must be of residential scale capacity. • A cooperative facility serving multiple adjacent properties may be permitted. • Turbines may send excess power to the grid consistent with netmetering provisions.
Safety	• Turbines should be located and designed to prevent unauthorized access. • Equipment that is non-functioning or abandoned for two years or more must be removed. If not removed by the owner, the City has the right to remove abandoned equipment at the owner's expense.

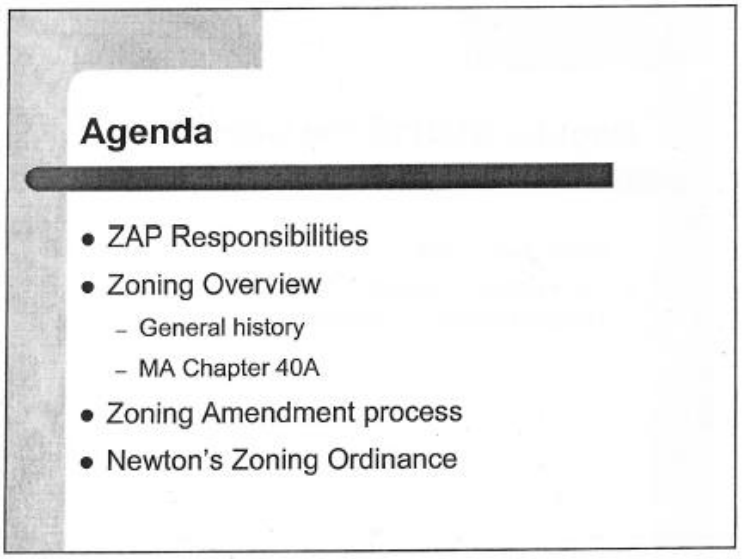
AS OF RIGHT

Applicability	• Building-mounted wind turbines only. • In Res C 3, C 3-A, C 3-B, and SD-6 zoning districts. • For research and educational purpose and accessory to educational uses only. • Equipment may be placed as of right on existing, non-conforming buildings as long as the placement meets height, setback, and other requirements noted below. • Temporary installations up to two years; renewable.
Height	• Wind turbines may be up to 40 feet over the building height, measured to the highest point of the turbine.
Setback	• 200 feet from the nearest residential use (not including dormitories owned by the educational institution and hotels or other transient accommodations as defined in the zoning ordinance). • Setbacks from the parcel line adjacent to a public right of way or non-residential use not owned by the educational institution will be as follows: Turbine height — Setback < 10' — no setback required 10' - 20' — 25' setback > 20' — 50' setback
Time	• Turbines shall be permitted for two years, which may be extended by a request to the Building Department.
Requirements	• Wind energy equipment shall comply with building setbacks on the parcel. In districts with formula setbacks, the height of a building-mounted turbine shall not be considered when computing the setback. • Only instrumentation related to the turbine, energy generation, and wind energy monitoring are permitted. Wind turbines may not be used to mount cellular/mobile phone equipment. • Wind turbines may not be used for signage or for display of advertising except for

	standard, unobtrusive identification of the manufacturer. • Wind turbines may be lighted only if required for safety by local, state, or federal regulation. Any lighting shall be shielded from abutting residential properties. • Brightly colored turbines may not be permitted unless required by the Federal Aviation Administration or safety considerations. • Wind turbine installations on a site must be rated to meet the requirements of the Cambridge Noise Ordinance, cumulatively, for all turbines and mechanical equipment on the site. • Turbines must be sited so that laydown for maintenance occurs within the property, not on adjacent lots or on the public way.
Power capacity	• Commercial power generation facilities will not be permitted in residential districts.
Safety	• Turbines should be located and designed to prevent unauthorized access. • Equipment that is non-functioning or abandoned for two years or more must be removed. If not removed by the owner, the City has the right to remove abandoned equipment at the owner's expense.

Appendix G – Introduction to the Zoning and Planning Committee





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Business Referred to ZAP

1. Matters relating to Inspectional Services Department, Planning Department, Conservation Commission, and Historical Commission, such as budget, policy oversight, capital improvements
2. Appointments to/policy oversight of the Planning Board, Economic Development Commission, Zoning Board of Appeals, Historical Commission, Historic District Commissions, Conservation Commission
3. Zoning map and ordinance amendments (except those related to specific individual parcels that go to Land Use Committee); matters relating to the Community Development Block Grant Program, Newton Community Development Authority, comprehensive planning, open space planning and maintenance of conservation land

Regular Staff to the Committee

- Karyn Dean, Clerk
- Marie Lawlor, Assistant City Solicitor
- Jennifer Molinsky, Principal Planner

A Brief History of Zoning

- First adopted in 1916 by New York City to regulate use and development of land
- Became standard adopted around country
- Based on separation of uses, protecting health, safety, property values, enjoyment of property by separating noxious / incompatible uses
- Upheld by Supreme Court as Constitutional in 1926 as valid exercise of police power

A Brief History of Zoning

- Now the principal means of regulating development, implementing comprehensive plans
- Traditional ("Euclidian") zoning separates uses, but newer trends include:
  - Performance zoning, with focus on mitigating effects of development
  - Form-based zoning, with focus on building/urban form rather than uses
  - Incentive zoning for desirable development (e.g. density bonuses for providing public space)

Zoning Features

- Typically, zoning regulates:
  - Building dimensions and location on a lot – height, mass (floor area), setbacks, frontage requirement
  - Density – minimum lot size, mass -
  - Use
- Flexibility in zoning / exceptions to zoning:
  - Special permits (SPGA)
  - Variances (ZBA)
  - Nonconforming uses and structures (Zoning)
  - In MA, Chapter 40B, Comprehensive Permits (ZBA)

Zoning Features

- Special Permit:
  - An approval for something that is not allowed by right but is expressly authorized by the Zoning Ordinance subject to certain criteria
  - Zoning Ordinance spells out cases where special permits may be granted by Special Permit Granting Authority (SPGA) and conditions that must be met
  - In Newton, SPGA is **Board of Aldermen**
- Variance:
  - Relief from zoning when some aspect of a property *cannot* meet zoning; it is an exception from zoning
  - Strictly, applicant must demonstrate ***hardship*** -- e.g. that zoning requirements cannot be met because of some condition unique to a particular lot (such as lot configuration)
  - **ZBA** grants/denies variances

Zoning Features

- Lawful nonconforming building or use:
  - "Grandfathered"
  - Predated zoning or conformed with zoning at the time building was constructed or use began
  - Can become conforming with change in use, building, or zoning
  - Special procedures, rights for nonconforming buildings or uses
- Illegal building or use:
  - Not allowed by zoning at the time built or when use began

Mass. Chapter 40A

- MA Home Rule (1967) grants right of self-government to cities and towns
- In MA, present zoning enabling act is MGL Chapter 40A (1975), which imposes limits on municipalities' exercise of home rule powers in the context of zoning
- Zoning in Ch. 40A means "ordinances and by-laws, adopted by cities and towns to regulate the use of land, buildings and structures to the full extent of the independent constitutional powers of cities and towns to protect the health, safety, and general welfare of their present and future inhabitants"

Mass. Chapter 40A

- Recognizes multiple zoning objectives:
  - Lessening congestion
  - Avoiding incompatible uses
  - Fire safety and provision of water and sewer, drainage, and adequate light and air
  - Providing adequate open space
  - Conservation of natural resources
  - Encouragement of housing for all income levels
  - Encouragement of consideration of comprehensive plan

Mass. Chapter 40A

- Limits zoning authority in particular uses/cases, including:
  - Building materials/methods (Building Code regulates)
  - Agricultural uses
  - Religious/educational uses (Dover Amendment)
  - Family daycare and child care facilities
  - Interior of single-family residences
  - Solar energy
  - Anything inconsistent with state law
- "Spot zoning": arbitrary treatment
- "Uniformity": code must apply uniformly

Zoning Amendments Under 40A

1. Petition
2. Public hearing before Planning Board, ZAP (14 day notice required)
3. Planning Board Report (21 days after close of hearing)
4. ZAP Working session(s)
5. ZAP vote
6. Board of Aldermen vote (2/3 vote needed to pass, must occur within 90 days of close of hearing)
7. Mayor approves

Zoning Amendments

- Zoning amendments are legislative actions
- Amendments to other parts of City Ordinances have different procedures – for example, may not require public hearing

Role of Planning and Development Board

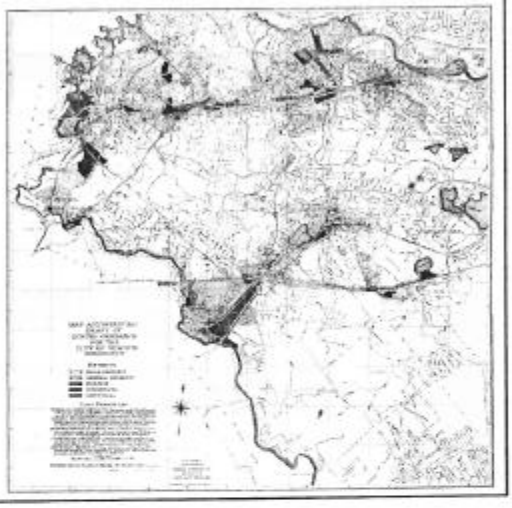
- As a **Planning Board,**
  - Advises the Board of Aldermen on zoning petitions; sits with ZAP at public hearings
  - Discusses other land use, zoning issues, and makes recommendations on proposed historic landmark designations
- As a **Board of Survey,** makes subdivision recommendations
- Serves as **Advisory Board** to the Newton Community Development Authority which issues loans for Housing & Community Development
- 6 full-time members, up to 5 alternates

Role of the Zoning Board of Appeals

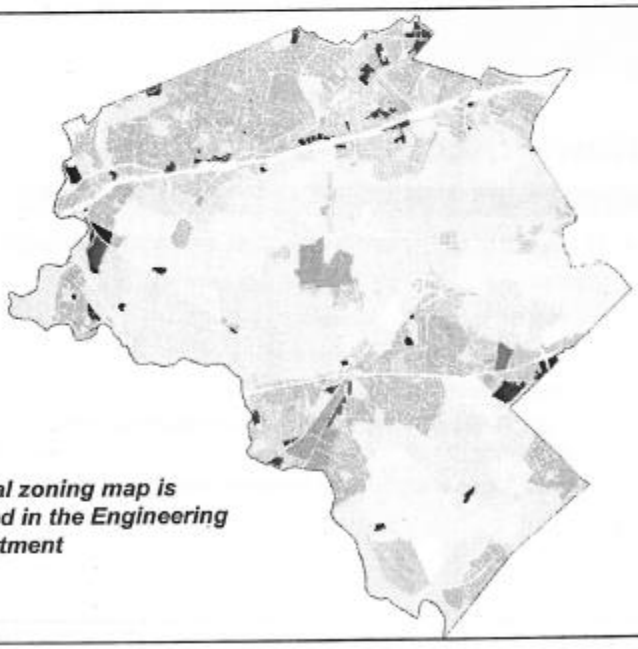
- Responsibilities:
  - Variances
  - Comprehensive Permit (40B) proposals
  - Appeals of decisions of the Commissioner of Inspectional Services
- 10 members (5 full, 5 alternates)

Newton's Zoning Ordinance

Adopted 1922 to advance the health and development of the City



Zoning map to accompany 1921 draft of zoning text



Official zoning map is located in the Engineering Department

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Newton's Zoning Ordinance

- Major overhauls in 1940, 1953, and 1987
  - 1940: single residence zones divided; lot area and frontage requirements established
  - 1953:
    - Changes moved Newton toward LESS density, with more restrictive dimensional controls
    - Did not sunset prior standards (as done in other communities), resulting in current two-tier system where controls for "old" and "new" lots differ
  - 1987: reorganization; MU zones added to Needham Street as well as new controls added for institutions and commercial development, dormitories

Newton Zoning Ordinance

- Numerous other amendments, revisions through the years:
  - 1989: Accessory apartments
  - 1997: Residential floor area ratio
  - 1998: Wireless section
  - 1999: Regulations relating to accessory buildings, including garages
  - 2003: Inclusionary housing ordinance revisions

Recent Changes to Ordinance

- FAR revisions (2008/9)
- Inclusionary housing amendments (2009)
- Grade change/engineering review (2009)
- Green building requirement (2007)
- Planned Multi-Use Business Development (PMBD) (2007)

Oxford House on Walnut St. includes inclusionary units

Purpose of Newton Zoning (Sec. 30-2)

- Encourage most appropriate use of land, including consideration of Comprehensive Plan
- Prevent overcrowding of land/undue concentration of population
- Conserve the value of land and buildings, natural resources
- Encourage efficient use and conservation of natural resources/energy
- Lessen traffic congestion
- Assist in adequate provision of infrastructure and public facilities
- Preserve and increase amenities and aesthetics of the city
- Encourage housing for people of all income levels
- Reduce hazards from fire and other dangers
- Provide for adequate light and air

Major Sections of Ordinance

- **Front literature: recent amendments not yet integrated into text, but in force**
- **Article I:** definitions, purpose, division into districts, uses allowed in all districts / special permits allowed in all districts
  - Public use, open space/recreation, single residence, multi residence, business, manufacturing, mixed uses
  - Uses allowed in all districts
- **Article II:** uses allowed in each district and dimensional controls
  - Includes specific regulations for certain uses, such as home businesses, accessory apartments, dormitories, wireless uses
  - Dimensional controls include required lot size, frontage, setbacks, heights, floor area ratio, etc.

Major Sections of Ordinance

- **Article III:** parking and loading, signs, nonconforming uses
  - Regulations for number, location, design of parking spaces, bike parking, off-street loading, and signage
  - Regulations regarding buildings or lots that are lawfully nonconforming, including special permits, *de minimis* provision
- **Article IV:** zoning administration regarding accessory apartments, site plan review, special permits
  - Special permit section includes green requirements and inclusionary housing section
- **Article V-VII:** change to lot size; ZBA, enforcement, adult uses, other

Challenges of Ordinance

- Can be difficult to follow, lacks detailed index, lacks use table
- Old/new lot dimensional controls can be difficult to interpret for citizen users of ordinance
- Some internal inconsistencies (e.g. parking in setbacks)

Zoning and the *Comprehensive Plan*

- Zoning is our primary tool for regulation of development and implementation of *Comprehensive Plan (2007)*
- *Comprehensive Plan* sets out goals for zoning, such as:
  - Consideration for overlay districts for village centers, encouraging more mixed uses in villages
  - Amendments that would encourage more affordable housing
  - Revisions that would clarify and update zoning and better reflect City policies

Newton Centre, Needham Street

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Other Ordinances/Regulations that Regulate Development

- State Building Code
  - Newton has adopted the optional "stretch" code
- Other Newton Ordinances
  - Conservation Commission (Ch. 22)
  - Historical Commission and Historic Districts, demolition delay, landmark preservation (Ch. 22)
  - Fence ordinance (Ch. 20)

Results of demolition delay

Appendix H – Team Assessments

We have consistently been striving to improve our revision and edit process. Before we start revising drafts, we assign each other specific sections to read though and edit in order to avoid having multiple people revise the same sections simultaneously. When we revise each other's drafts, we track changes in order to identify our weaknesses in writing that we can improve on. We also regularly insert comments into each other's drafts to more specifically point out problems to address. Throughout this term we have each made steady progress in our writing by considering all of our comments. In addition, we have taken special care to address all of the feedback on drafts that our advisors returned to us. We often have thoughtful group discussions when we do not understand any comments or we disagree on the best way to address a comment. Even though we have been making steady progress effective team writing, we will still need to work on further streamlining the writing process in order to minimize the time necessary to produce quality work.

We have been working to develop a proficient system optimizing the quality of our presentations. The strong progress of our presentations was mostly due to our rigorous preparation process. First, we each would develop our own individual speeches for our own parts. Then we would go through the presentation together and thoughtfully critique and give feedback to each group member to improve the quality of our presentation. This step allowed us to make sure our presentation was clear, professional, and well integrated all our parts. We would then continue to go through as many presentation cycles or more while still giving each other advice along the way, in order to make sure that we each had a clear understanding of what we would say for each of our respective parts. We also would do a quick run through of our presentation once or twice right before formal presentation. Once the presentation was over we would take notes on the comments and questions from our Advisors. We used this feedback and incorporated it into our future presentations. By following this guideline we were able to deliver effective and professional presentations. Even though our process has been successful so far, it consumed a considerable amount of time. In order to better manage our time preparing for presentations, we will practice our individual parts on our own in addition to just as a team. This would allow us to become more confident with our respective parts much more quickly.